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PUSHING UP THE CEILING

"WHEN," we asked last week, "is this country going to make a serious start on plans for interplanetary exploration?" We quoted Air Chief Marshal Sir John Baker who had said that the hall-mark of the air tomorrow will be manned satellite flight. We did not expect then, and do not expect now, to get more than a dusty answer at this stage from the Authorities but we are particularly pleased that in this issue we have been able to devote three pages to a masterly study by Mr. J. E. Allen, B.Sc.(Eng.), A.F.R.Ae.S., A.M.I.Mech.E., B.F.I.S., head of the Aerodynamics, Projects and Assessment Department of the Avro Weapons Research Division at Woodford.

In the course of his paper the author says that aeronautics and astronautics are about to embark on a most fascinating period of exploration of altitudes and speeds which have been only tentatively evaluated so far. He suggests that, in the new emphasis on research and on new experimental techniques, new shapes must be expected to appear; not only the ballistic missile with its blunt nose but the hypersonic aeroplane and hemispherical satellite.

These are things which people have hardly begun to discuss in this country as yet. Mr. Allen refers to a belief, general here at the moment, that outer space is solely the domain of the Americans and Russians and that, because satellites are expensive, Britain cannot enter this new field.

We have given much space to Mr. Allen's paper because we are certain that the young men in this country are not going to be content to see Britain get off to a poor start in the exploration of nearer space. It is a matter for congratulation that the Manchester branch of the oldest aeronautical society in the World arranged for such a stimulating lecture.

By the time our next issue appears, the eagerly awaited White Paper on Defence for 1958 will have been published. The general expectation is that it will not do anything to restore the place of the manned military aircraft against the missile. On the other hand, the realization does seem to be growing that, if our Central Army Reserve is to be truly mobile, Transport Command will require more aircraft.

Now these official pronouncements about policy have, as is obvious, effects at all levels of national aeronautical endeavour. And at a stage when so much visible, and invisible, effort is being devoted to guided-weapon development it is clear that the already much reduced effort on manned aircraft is in danger of even further reduction. Thus, suppose in research at this time we are only devoting to manned aircraft 50% of the total research effort available, a cut of 20% is not going to reduce the effort to 80% but to 40% of what could be done. And we cannot expect to continue expanding our aeronautical exports if we allow our research effort to fall off.

Against such a situation it is scarcely encouraging to read certain remarks made by the Minister of Supply, Mr. Aubrey Jones, at a lunch in London on February 7. Noting that the production of civil aircraft requires a great deal of finance which, since the business is very speculative, is difficult to come by, Mr. Jones noted that such finance is much more readily got if aircraft are manufactured as a part of a wide range of industrial activity. He therefore gave as his opinion that it is in the interest of the aircraft industry to diversify itself. We cannot imagine any aircraft organization having any spare effort to diversification in these days of increasing aeronautical complexity. Mr. Allen's paper makes very clear indeed the new fields with which the aeronautical engineer will have to make himself familiar if the manned products of the industry are to fly ever higher, faster and farther.

In fairness to Mr. Aubrey Jones we should also point out that in the course of his speech he spoke of security and the attitude of his Ministry towards it. He had been asked whether security restrictions could not be lifted more speedily in order to facilitate exports. He expressed his sympathy with the request and pointed out that the Ministry of Supply is a Department of scientists. And scientists, he went on, do not really believe in secrets; it was the military who hung on to secrets far too long. It was a point in favour of an independent Ministry of Supply that the scientist could press his case better from within such a civil organization than he could from within a military department.

It is ironic that Mr. Jones' remarks on secrecy to the radio and radar manufacturers should have preceded so closely the publication of Sir Robert Watson-Watt's autobiography, of which a review will appear next week. Radio-location was, we suppose, one of the best-kept military secrets ever. And it was certainly produced by scientists. Why their tall towers did not give the game away we shall never understand; on one occasion a map compiled from the air by a young enthusiast was brought into the pre-war offices of THE AEROPLANE. It showed the coastwise location of the towers and was accompanied by the suggestion that if it were published someone might be able to explain what these erections were intended to do!

MATTERS OF MOMENT

U.S. Aid for the NA.39

A CONSIGNMENT of test equipment worth half a million dollars has been received by Blackburn and General Aircraft from the United States. It will be used in the development of the NA.39 naval strike aircraft. The equipment has been supplied on a Government-to-Government basis under the Mutual Weapons Defence Project. Other consignments are expected; they will be worth more than that already received.

This aid from America was mentioned by the company's chairman in his annual report last year. He said: "It is not without interest that as part of defence aid the U.S. Government is bearing some of the cost of development of the aircraft and will also provide a large amount of equipment of a type not available in this country to assist rapid . . . flight testing."

The equipment which has been received was built by the Benson-Lehner Corporation of Los Angeles. It comprises advanced computing apparatus for the rapid reduction and analysis of flight-test results.

Powering the World's Aircraft

NO LESS than 34.8% of the figure of £116,471,110 announced by the S.B.A.C. as the total worth of Britain's aircraft-industry exports for 1957 (referred to in our issue of January 31) was in respect of aero-engines and spares. The total value—£40,642,162—represents an increase of a third over the previous highest figure, attained in 1956.

It was in 1950 that engines first began to be a significant proportion of British aviation exports, and they have represented an almost steadily increasing percentage ever since. They rose from 15.4% in that year to 18% in 1951, 19.2% in 1952, 30.7% in 1953, 37% in 1954, 33.5% in 1955, and 27% in 1956.

An even more welcome aspect of the situation is the growth in the number of licence agreements signed between British manufacturers and overseas countries. At present five British companies have agreements with nine countries abroad for the manufacture of 16 types of aero-engine. The Argentine holds a licence to build Rolls-Royce Derwents; Avons are made in Australia, Belgium and Sweden, and France has a licence to make them. The Tay has been built in the U.S.A. as the Pratt & Whitney J48 and in France (as the Hispano Suiza Verdon) for the Mystère IVA.

American-made Nenes (Pratt & Whitney J42) power the Grumman Panther and Rolls-Royce has an agreement with Westinghouse for an exchange of technical information and the production by the American company of a version of the Soar as the XJ81, a powerplant for drones and missiles.

The Wright company has built about 10,000 Armstrong Siddeley Sapphires as the J65, which powers nine different types of military aircraft, and has the licence to produce the Python, Mamba, Double Mamba and Viper.

In France the S.N.E.C.M.A. company has a licence for the Bristol Hercules, and

SIGNIFICANT SIGNATURES.—On February 7 the air agreement between the U.K. and Australia was signed in London by Senator Shane Paltridge, the Australian Minister of Transport, and Mr. Harold Watkinson. A note on Senator Paltridge's visit appears on page 198.

SUSTAINED SUPERSONICS.—A continuous flight at supersonic speed lasting for 23 minutes was achieved by an English Electric Avon-powered P.1B flown by Mr. R. P. Beamont recently. The flight was from Boscombe Down to Warton and supersonic speed was reached one minute after take-off.

Photograph copyright "The Aeroplane"

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licences for the Orpheus turbojet have been granted to Italy (Fiat), India, U.S.A. (Wright TJ37) and France (S.N.E.C.M.A.). The Zephyr is a Wright-Bristol development of the Olympus, and Bristol Aero-Engines is negotiating for further licences with Wright.

D.H. Ghost turbojets are produced in Italy by Fiat and in Switzerland by a State factory, and D. Napier and Son has an agreement with the American Aerojet-General Corporation for a full exchange of information, primarily with regard to the Scorpion rocket motor.

And finally, one of the S.B.A.C.'s Canadian members, Orenda Engines, has agreed that the Wright company is to build the Iroquois, the most powerful jet engine yet announced.

Encouragement for Electronicists

POSSIBLE effects of the Government's cuts in defence expenditure on the electronics industry were described by the Minister of Supply last week as likely to be far less devastating than in the case of the aircraft industry. Speaking at the annual lunch of the Radio Communications and Electronic Engineering Association, Mr. Aubrey Jones said that the aircraft industry was faced with a change from one vehicle to another whereas "electronics go on no matter what the vehicle, and are becoming more and more complicated."

He thought that the level of Government spending on electronics would remain unchanged—for some years, at any rate. This, however, did not mean that its composition would remain unchanged; it might well be spread over fewer firms and over fewer contracts than now, but the rough volume should be the same. Later he said that he and the M.o.S. regarded the electronics industry as one of our most important.

Helicopters in Service

A REMARKABLY fine film about helicopters in service was shown to a most distinguished company in London last week. Some four hundred guests had accepted invitations from Westland Aircraft, Ltd., and were received by Mr. and Mrs. Eric Mensforth. Members of the Board of Admiralty, of the Air Council and the Conservative Air Committee were present. A strong contingent from B.E.A. was headed by Lord Douglas with whom was Lady Douglas. Indeed it is some time since so many people from so many branches of aviation have been gathered together—and in great harmony in spite of the wide divergence of views now known to exist between some members of the Ministry of Supply and the industry.

The film, about which there seemed to be widespread approval, depicted the development and utilization of the single-rotor helicopter with its noteworthy characteristic of simplicity in both aerodynamic and mechanical aspects. It opened with shots showing Westland helicopters in service in the jungle struggle against terrorists in Malaya, where the helicopters ensured that though the small groups of men might be operating independently, they were not alone.

Flash-backs showed the essential contribution of Cierva and his Autogiro. It was interesting to be reminded by an excellently clear sequence that the famous single-rotor helicopter, in which Igor Sikorsky made his historic flight of one hour, used two auxiliary rotors, one for control in pitch and one for control in yaw.

We understand that copies of this film may be obtained from Westland Aircraft, Ltd., for showing on suitable occasions.

The Kilowatt Speaks

REVIEWING "Three Steps to Victory" (Odhams, 30s.) our reviewer "NAVIGUS" apostrophizes its author, Sir Robert Watson-Watt as "the Father of Radar, the Enfant Terrible of Navigation." The observation continues:—

"Sixty-six inches of dynamic energy, generated in a Scots cathedral city nearly 66 years ago, his career has had an electrical effect on the development of the electronics industry. His book is built on a similar square plan, being nearly 500 pages thick. Like the man, it vibrates at such a high potential that shocks to the less well-insulated reader must be expected."

A full review will follow next week.

Man from Canada

G. W. GRANT McCONACHIE, president of Canadian Pacific Airlines, struck U.K. like a genial tornado last week. He arrived from Vancouver, C.P.A. headquarters, on Tuesday and left last Friday, a day before scheduled, to deal with the new Canadian Government's expected announcement which would in effect allow C.P.A. to compete equally in Canada with T.C.A. In the three days he visited Belfast to see his Britannias, the first of which is now on maker's flight test, with customer's acceptance trials due to begin on February 21 and final take-over on March 21; he visited Bristol and Hatfield to look at their jet-liner projects; he spoke a lively piece for TV on arrival and another for radio before departing, while packing, dispensing information, sociability and Scotch.

Grant McConachie is a tower of a man, in physique and capability, the Englishman's idea of what a pioneer Canadian bush-pilot who now leads an international airline ought to look like. A true—and young, under fifty—son of the Commonwealth, his approach to the buying of new equipment might be summed up as "I'll take British, unless the Americans can show me something better—in the air and not on paper. If I wanted paper aeroplanes I could draw them myself." In practice C.P.A. become the third or fourth customer to get a new type, so that most of the bugs are out of it but it's new enough to attract passengers away from the opposition's older equipment. We see it in their Britannias, we would have seen it in their Comet Is.

"The Britannia," says Mr. McConachie unequivocally, "is the finest airliner in service." On jet airliners he spoke like a D.H. salesman. There are, he pointed out, 128 international airports; only 14 of them can take the big American jets. The Comet, which can work them all, is, in his opinion, an airliner with a big future. But until C.P.A. turn to jets, as they will do when "real" range and duration are offered, the Britannia will be more than adequate for their extensive international services. It will replace the DC-6B now serving their Vancouver-Amsterdam run, reducing time from 18 to 12 hours. Mr. McConachie looks forward to C.P.A. being allowed to fly into London from Vancouver. At the moment the British—Canadian Government policy is, he said, driving North America's West Coast London-bound traffic to use non-Commonwealth carriers. It was interesting to note that on the Vancouver — Amsterdam Polar route the Canadian Pacific Airlines aircraft were never more than 90 minutes from an airfield, even on the Atlantic crossing.

This big Canadian's approach to C.P.A.'s kind of route is based on the globe rather than the map, understandable with an airline flying 33,694 miles of international routes stretching from Vancouver to the Orient, Australia, South America and Europe. This as well as 6,915 miles inside Canada. Not bad for an airline which started only 16 years ago as a scattered group of small "bush" operations in Northern Canada.

Mr. McConachie expects a "Freedom to Compete" charter from Canada's Conservative government if, as seems likely, it is returned again at the forthcoming election. Extension of his airline's domestic services across Canada, hitherto denied, may lead in time to more orders for suitable British aircraft. I'm sure Mr. McConachie would say, "You fly 'em, we'll buy 'em."—WREN.

Over to Astronautics

A MASTERLY review of the transformation from aviation to astronautics and some significant forecasts of developments that are gradually beginning to emerge from current World-wide effort in guided missile and Earth-satellite technology were given in Manchester recently by Mr. J. E. Allen, B.Sc.(Eng.), A.F.R.Ae.S., A.M.I.Mech.E., F.B.I.S., head of aerodynamics, in the projects and assessment department of Avro's Weapons Research Division. He opened his lecture, which was to the local branch of the R.Ae.S., by saying that the successful launching of the Sputniks showed beyond all doubt the feasibility of elementary space flight. This alone would be enough to attract World-wide interest, but what ought to have been a straightforward contribution to the I.G.Y. set off a tumult of political fireworks.

It is difficult to recall a more powerful reaction occurring in peace-time. An astonishing amount of information poured from the Press, radio and television, making it difficult to ascertain the real technical status of space flight at the present. A correct view of astronautics is vital because of its implications to the balance of the World's industrial and scientific activity. Already the two greatest Powers have allocated substantial portions of their budgets to interplanetary objects.

After briefly surveying the history of astronautics since the time of the Wright brothers, the lecturer surveyed current achievements in high-altitude aircraft, guided weapons, high-altitude rockets, and the satellite vehicles. This led him to the main part of his thesis and his prophecies of developments.

Future Design Trends

Aeronautics deals with the carriage of objects from one part of the Earth to another through the atmosphere and future design trends will be influenced by the needs for improved performance, i.e., altitude, speed and range. These three are inter-related.

Altitude may be needed for its own sake for physical exploration or for the avoidance of attack. Alternatively it may be desired to permit higher speed or increased economy of operations as in the jet aircraft.

Speed increases may be wanted to shorten the time spent on voyages, to reduce the guidance errors of missiles, or to decrease the chance of interception. High speed is an essential prerequisite to range in rocket vehicles either of the ballistic or boost-glide type. Indications are that aeroplanes and missiles will continue to develop to higher speeds and altitudes.

Design considerations are dominated by the two classes of propulsion available—air-breathing jets and rockets. Turbojets and ramjets are capable of development to speeds far exceeding those of today. N.A.C.A. have expressed their belief in the turbojet at a Mach number of 4, and a hypersonic ramjet for M = 6 has been reported. Whatever advances are made with these systems, however, they are unlikely to be able to operate at altitudes much above 100,000 ft. A good deal of energy is imparted to a vehicle in the first 100,000 ft. of its flight into space and it is probable that air-breathing units will be used in some types of interplanetary vehicles because of their superior specific impulse over that of the rocket.

Rocket propulsion, being independent of the oxygen content of the upper air can extend the speed and height of aeroplanes considerably. The accompanying table indicates how Mach number varies with altitude for a typical supersonic configuration in level flight with a wing loading of 50 lb./sq. ft.

TABLE 1.—CRUISING CONDITIONS AT HIGH ALTITUDE

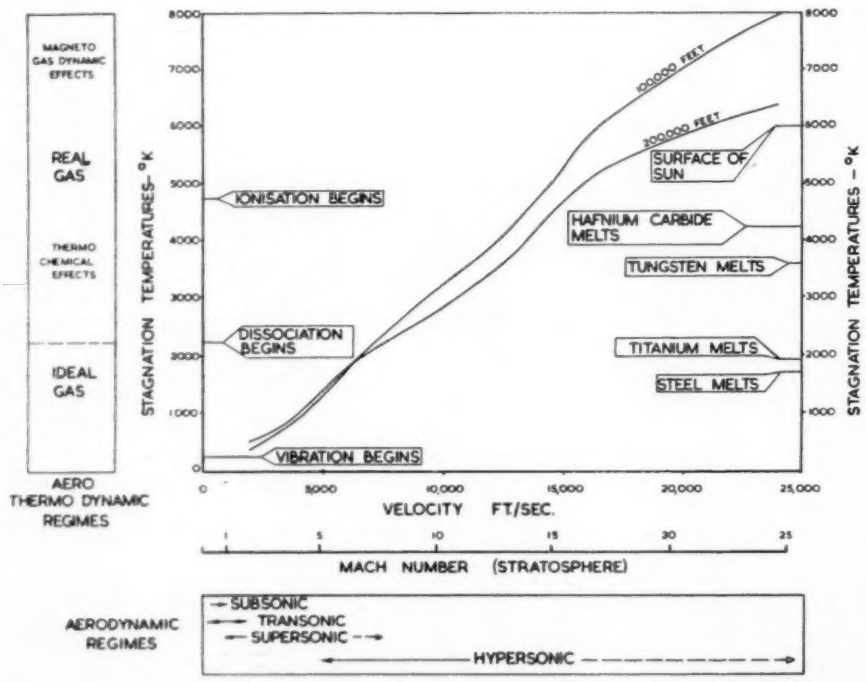
Altitude ft.	Altitude km.	Relative Density σ	Mach number	Stagnation temperature °K	Mean body equilibrium temperature °K
32,700	10	0.351	1.22	286	280
98,100	30	0.0156	5.8 (2.9)	1,550	760
163,500	50	0.0010	21.1 (10.6)	6,000	1,020
186,200	60	0.00029	40.6 (20.3)	TOO HOT	

Wing loading 50 lb./sq. ft. Turbulent boundary layer (Wing loading 12½ lb./sq. ft. in parentheses). Surface emissivity = 1.0.

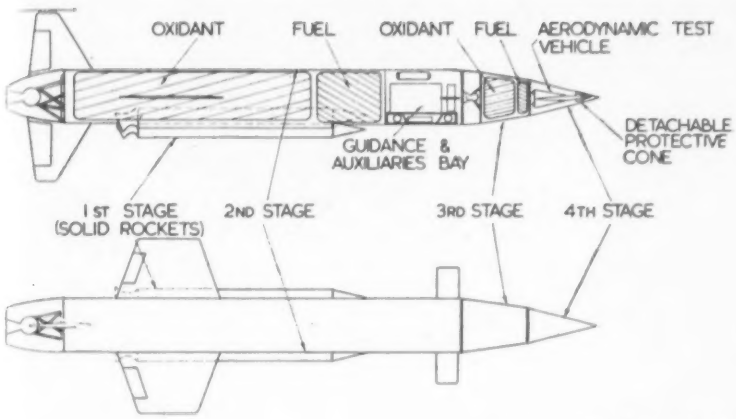
Although rocket propulsion systems can accelerate an aircraft to Mach numbers of 10 or more the increase of altitude is disappointing, bringing as it does some very high skin temperatures. Even reducing the wing loading to such a low value as 12½ lb./sq. ft. the altitude only increases to 160,000 ft. at a Mach number of 10. An altitude of 200,000 ft. seems hard to attain in straight and level flight. Haber has made an analysis of the difficulties of human flight in those regions of the upper atmosphere which he called the Aeropause.

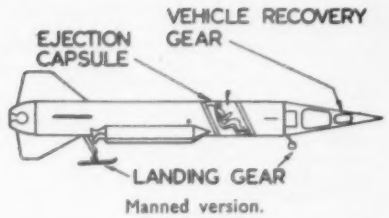
There have been many proposals for large rocket aeroplanes for both civil and military uses and one example will suffice, that for a transcontinental passenger carrier put forward by Dornberger in 1955. This aircraft was designed to fly from London to New York in 1½ hr. and its maximum range was 5,200 nautical miles. The technical requirements seen by Dornberger, e.g., controllable rockets, hypersonic configurations, guidance and control have been tackled vigorously in recent years but the practical problems such as noise at the take-off and diversion of the glider from a congested terminal airport will have to be overcome before such devices become attractive for civil use.

There is no doubt, however, that the hypersonic rocket aeroplane, missile or interplanetary ferry is at the present moment receiving a great deal of attention. The North American X-15, claimed to be the first true hypersonic boost-glide aircraft, is an outcome of this work. It is expected to fly this year, is probably launched from a B-52 and, according to Press reports, it should exceed a Mach number of 5 and reach altitudes between 200,000 and 800,000 ft., the latter in zooming flight. It is stated to be intended for manned re-entry experiments at altitudes where normal aerodynamic control surfaces are ineffective. Control by adjustable air jets is a means of dealing with this and a ground

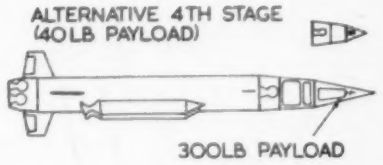


The relation between stagnation temperatures and Mach number in the atmosphere.

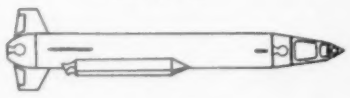




Manned version.



Space probe.



Satellite.

The hypothetical aerodynamic experimental test vehicle for very high speed flight at very high altitudes, proposed by Mr. Allen in his lecture.

rig for such a system has been built and tested by N.A.C.A.

There are persistent reports that the Russians are developing a boost-glide bomber, the T-4A, for ranges between 4,000 and 10,000 miles and 120 miles maximum altitude, using an 820,000-lb.-thrust rocket motor. Reports say it is now in the early flight test stages.

We may expect, therefore, to see aeroplane and missile performance steadily increasing in the next decade to values approaching those of satellites.

Rocket propulsion is the only means yet available for escaping the gravity of the Earth. Many billions of pounds have been spent in research and development of the large liquid rocket motors in connection with the V.2 and later I.C.B.M. ballistic rockets. The performance of the latter is of the same order as that needed for satellite flights of smaller payloads.

Guidance for aircraft and missiles has in automatic inertial and celestial navigation deserted purely Earth-bound aids to seek the references of inertial space and the stars. The precision of navigation needed for aircraft, missile and elementary space flight can be attained by comparable instrumental techniques. Associated with these guidance developments are those of complex electronic control and computing equipment. The need to cram quarts of electronic brains into pint pots of small interceptor missiles has given a remarkable impetus to miniaturization techniques such as transistors and printed circuits.

In the piston-engined aeroplane, "performance" was defined quite adequately by level speed and rate of climb values, changing with the introduction of jet aircraft to include zooming effects. Missile trajectories take this a further stage depending almost completely on complex digital computers for their evaluation. For advanced missiles one can no longer consider the Earth as flat—a liberty which aeronautics has been able to take for the sake of mathematical simplicity for over 50 years. For ballistic missiles, satellites and interplanetary flights the flight paths are now called orbits and will be solved by means of celestial mechanics, established by astronomers many centuries ago. Already maximum altitude is called "apogee" and minimum altitude "perigee."

There has been a major revolution in aerodynamics since 1940. Until then virtually all aeronautical applications were subsonic and it was obvious that much research was necessary for a better understanding of the theory of lift, drag, propulsion and interference for application with greater certainty in design. Since then aerodynamics has progressed through the transonic and supersonic regions to hypersonics. Mach numbers of 23 have been measured in free flight and 50 and 200 (nominal) in the laboratory. We can now truly say that a vast area of aerodynamics has been tentatively explored for there is no virtue in hurtling through the atmosphere at speeds exceeding satellite velocity. There is a tremendous amount of research still to be done but the broad physical characteristics of the different regimes have been mapped.

An accompanying figure shows the stagnation temperature associated with flight at various Mach numbers through the atmosphere. Temperatures of the magnitude represented will exist behind the strong normal shock waves created by a blunt body. As the internal energy of the air increases, the higher energy levels (such as vibration, dissociation, electronics and ionization) are excited resulting in much lower temperatures than those obtained from ideal gas theory.

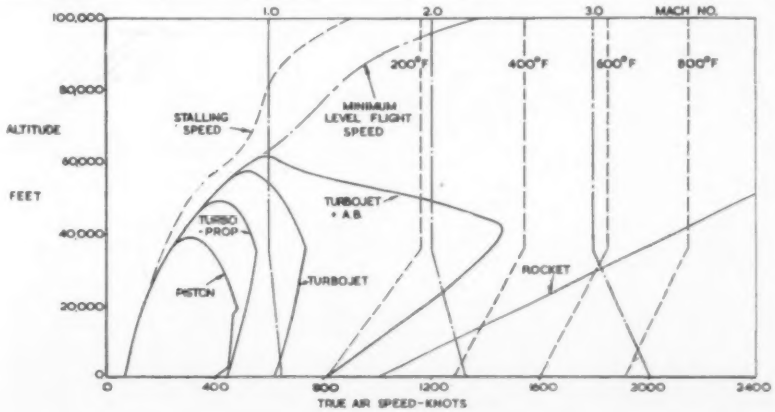
In addition to changes associated with the physics of the air at high temperatures certain chemical transformations take place. At room temperature, air consists of approx. 78% N_2 and 21% O_2 (by volume) with traces of other substances such as water vapour, argon, etc. At higher temperatures the air contains oxygen and nitrogen in both molecular and atomic forms and nitric oxide; free electrons and ions may also be present.

At very high temperatures free electrons are produced and these, moving in the boundary layer and wake, induce luminous discharges and electro-magnetic effects. Aerodynamics and astrophysics are brought closely together by the science of magnetohydrodynamics which deals *inter alia* with the formation of sun spots and solar prominences and the creation of radio noise in outer galaxies and also with the influence of conducting fluids on boundary layers and wakes. The N.A.C.A. has started experiments in these domains.

Immediate Targets in Space Flight

Clearly, whatever the ultimate objectives of space flight will be, a high priority must be first accorded to experiments measuring the physical, chemical and electrical properties of those regions of space extending a few thousand miles beyond the Earth. The physicist and astronomer have depended on indirect methods of determining these quantities for several generations, but space flight now gives the opportunity to make direct measurements.

The Russian Sputniks have demonstrated that the two major problems of placing satellites in orbit have been solved, viz., propulsion to five miles per second and precise guidance. By extensions of the present techniques, such as better propellents, lighter structures, miniaturized guidance and control gear and bigger vehicles, etc., larger payload satellites may be expected, going to far



Typical aeroplane flight envelopes.

greater distances than the first two. The Russians have officially announced their intention to fire objects to the surface of the moon, a task well within the reach of present technical capabilities. They have also spoken of sending transmitting laboratories to the surface of the moon.

The majority of experimental results can be obtained satisfactorily by telerecording, so the inability to recover after re-entry will not seriously hamper this work. It is inevitable that physical experiments will be succeeded by biological investigations prior to placing a man in and recovering him from a satellite orbit. This has not yet been achieved technically and presents difficulties yet to be overcome.

There are three means of bringing a satellite out of orbit: (a) By retarding rocket impulse. This is extravagant in weight. (b) By air resistance. The drag can be increased either by variable conical skirt or by steel parachutes. (c) By air lift. By this means there is greater measure of control over the flight path, provided steps are taken to allow for severe heating.

Some project studies have already been made of devices employing lift during re-entry.

Krafft Ehricke, now of Convair Astronautics, proposed a five-man three-stage orbital glider in which the last stage had highly swept wing surfaces. It had a very low wing loading of 11 lb./sq. ft. and was estimated to be capable of descending from a satellite orbit and landing on retractable skids. Weighing about a million pounds it represents an ambitious project.

Dr. Ferri, of New York, prefers a boat-shaped configuration with highly rounded, swept leading "edges." The payload or crew space is in the lee of the forebody and re-entry is made in a series of skips. Heat generated during a pull-up is radiated away during the subsequent path in free space and by this means the excessive weight of a heat sink is avoided.

Dr. Hilton, of A.W.A., considered the more severe case of re-entry from an interplanetary path at speeds greater than the orbital value, e.g., seven miles per second. In this case considerable downward lift is required to curve the trajectory parallel to the Earth. The associated high drag reduces velocity further, eventually to below the orbital value. The full brunt of the aerodynamic heating is taken on the flat pressure face which must be cooled or allowed partly to melt away. A near vacuum is formed on the lee side which reduces heat transfer to the payload.

Future Aerodynamic Research at Extreme Altitudes

Aeronautics and astronautics are about to embark on a most fascinating period of exploration of altitudes and speeds which have only been tentatively evaluated so far. We must be prepared for radically new shapes to appear. There will be a new emphasis on research and new experimental techniques. There is the ballistic missile with crucial or blunt nose re-entering at steep angle, the hypersonic aeroplane with highly swept and rounded leading edges cruising at above 100,000 ft. and the hemispherical satellite coming in at low flight path angle to be recovered by parachute. These configurations have quite different flight characteristics as shown in Table 2.

TABLE 2.—FLIGHT PATHS OF UPPER AIR VEHICLES

Class of vehicle	Altitude (ft.)	Mach No.	Flight path angle	Aerodynamic heating effects	(Duration)
IRBM (1,500 n.m.)	200,000	15	38°	800 kW/sq. ft.	(~15 sec.)
ICBM (5,000 n.m.)	200,000	23	23°	3,000 kW/sq. ft.	(~15 sec.)
Hypersonic glider	120,000	5-10	near 0°	5 kW/sq. ft.	(½-2 hr.)
Re-entry from satellite orbit	250,000	20	0-10°	High rates 100–1,000 kW/sq. ft.	(2-5 min.)
Experimental vehicle	250,000	10-25	0-10°	High rates 100–1,000 kW/sq. ft.	(2-3 min.)

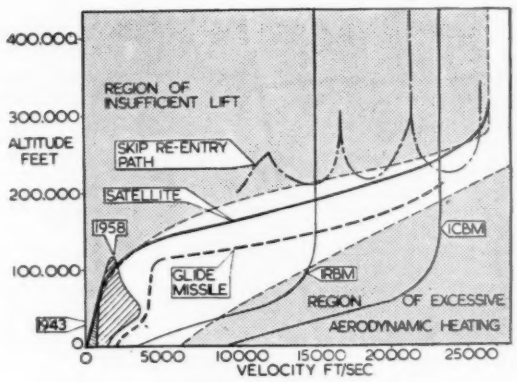
Experience gained with the re-entry of ballistic missiles will not be wholly relevant to the hypersonic aircraft or the re-entering satellite for both the angle of dive and the rate of heating are greater and the ballistic device does not require lift.

The flight regime in which these sorts of vehicle operate is now frequently referred to as the corridor of continuous flight into outer space. This is shown in an accompanying figure which compares the performance of 1943 and 1958 aircraft with the new regime which must soon be opened up.

A High-altitude Aerodynamic Research Vehicle

In order to illustrate some of the performance possibilities in very-high-speed, high-altitude flight in the flight corridor, I have selected a hypothetical aerodynamic experimental test vehicle which could be air launched from a Vulcan.

Air launching of experimental high-altitude vehicles is a well-known technique. A recent N.A.C.A. test vehicle is launched from a Martin B 57A (American Canberra) at 45,000 ft. It is a two-stage rocket which reaches a maximum Mach number of 10.5. Another application of the same concept was proposed



The "flight corridor" discussed by the author.

by Robotti, a consultant of Fiat, in 1956. A Convair F 102A carried a winged two-stage rocket built from V2 components and a WAC Corporal. By flight refuelling and launching at 46,000 ft. it was estimated to attain nearly 2,000,000 ft.

For some experiments the attainment of high Mach number is the primary objective, for others Mach number associated with a particular altitude is desired and for physical experiments altitude, irrespective of speed, is the aim. Air launching is also suitable for investigating an important class of re-entry flight paths from satellite orbits. These are characterized by flight path angles less than, say, 5° (rather than the 20-40° of ballistic rockets) and are associated with devices able to apply aerodynamic lift as well as drag in the control of their flight path. This seems to be essential if recovery of men or equipment is desired at some predetermined part of the globe.

For this reason the primary objective of the study I now propose is to project a 300-lb. aerodynamic vehicle containing instruments and telemetry equipment to Mach numbers exceeding 15 at altitudes of the order of 400,000 ft. and at small flight path angles to the horizontal. In any particular case, speed and altitude can be varied by choice of the initial climb path and performance and payload weight can be exchanged.

In the example given here a four-stage rocket-propelled vehicle is used. Three of these stages are propelled by solid, liquid and liquid rockets respectively. After launch at about 35,000 ft. in a gentle climb, the solid boosters accelerate the vehicle to a Mach number of about 2 and are jettisoned, possibly with some wing structure. The next stage, which contains the guidance and control equipment, accelerates to a Mach number of about 10 near 200,000 ft. After a long coast to increase altitude the last propulsion stage is fired. The test vehicle must obviously be separated from the third propulsion stage for the sake of the experiment.

This arrangement is not necessarily the optimum, for instance advantage might be taken of air breathing accelerators for the first part of the trajectory, below about 90,000 ft.

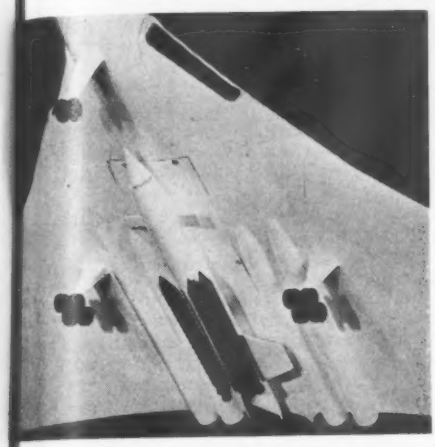
A vehicle of this type could fly other trajectories of current interest with alternative payloads. Farside (3 lb.) and Vanguard (5 lb. and 20 lb.) suggest that the physicist can be satisfied with far smaller payloads than the aerodynamicist and in such cases near-satellite performance should be possible. Alternatively, with a different wing, the vehicle could be flown more nearly vertically to place a payload of 300 lb. near 400 miles altitude (with three stages) and 1,000 miles (with four stages). A smaller but still highly useful payload of 40 lb. would, of course, go substantially higher. A manned version could assist aviation medicine experiments with a reduced performance.

No special merit is claimed for the air launching technique. There are very many ways of going about this kind of experiment; some are cheaper than others, and some offer more flexibility. As an indication of the immense possibilities for the immediate future over 250 projects have been submitted to the U.S. authorities for vehicles to operate beyond the atmosphere. This country, however, need not produce a rash of such projects, but I really do think we should be getting on with one or perhaps two of them.

I think there is a general belief in this country, at the moment, that outer space is the sole domain of the Americans and Russians and that, because satellites and their kind are pretty expensive, Britain cannot enter this new field.

It is clear that, to follow exactly the American and Russian policy would indeed be unwise, but this country has a rich scientific heritage and should earnestly set about procuring the experimental devices needed by the physicists, chemists and engineers to probe those regions of space beyond the capabilities of our present equipment.

NEWS OF AIRCRAFT, ENGINES AND MISSILES



FOR RESEARCH.—This very-high-speed research vehicle, for high-altitude exploration and suitable for launching from a Vulcan, was proposed in a recent R.Ae.S. branch lecture by J. E. Allen of Avro's Weapons Research Division. (Summarized on pages 194-196.)

EXECUTIVE VAMPIRES.—Twenty-six ex-R.C.A.F. Vampire 3s have been bought by a Milwaukee firm. Said to be the first Service jet aircraft ever sold for civilian use, they will be used for executive and photographic work. For the latter rôle an extended nose section is to be fitted.

MIXED POWER.—It is reported that a mixed-powerplant version of the Jindivik target drone is being considered. The use of an external rocket engine would allow a height of 70,000 ft. to be attained.

JAPANESE WIDGEON.—Mr. K. Ishizaki, the London Manager of the Marubeni-Iida Co., Ltd., recently took delivery of the first Westland Widgeon for Japan. It is to be used by the Tohuku Electric Power Co. for power-line survey and maintenance and supplements two Dragonflys which have been in use for a number of years.

MILITARY ELECTRA.—Five versions of the Lockheed Electra for military rôles have been suggested: High-speed freight transport, air ambulance, military personnel transport, navigational trainer and radar and electronics-jamming trainer.

SECOND TAON.—The first flight of the second Breguet 1001 Taon, powered by a Bristol Orpheus turbojet, was on January 18. The pilot was Bernard Witt.

KENYA AIR SHOW.—Among the aircraft taking part in the air display at Nairobi's new airport on March 9 will will be a Comet 2E operated by B.O.A.C., a Hunting-Clan Viscount and V-bombers from the R.A.F. The S.B.A.C. is taking an interest and some individual members are arranging to participate, as also are the aviation companies operating in East Africa and the many local private owners.

"The Aeroplane" Next Week

THE issue of THE AEROPLANE for February 21 will be an enlarged Powerplants Number. It will contain specially prepared articles on various aspects of powerplant technology covering turbojets, rocket engines and ramjets. There will also be a comprehensive review of the World's aero-engines with tabulated data.

The price of this special 50-page issue will be the usual 1s. 6d. To ensure getting it readers should place orders in advance with bookstalls or newsagents or with the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1.

BELGIAN LIGHTWEIGHT. — The latest production by Mr. O. E. Tips is the Tipsy Nipper, a single-seat open-cockpit monoplane with a nose-wheel landing gear, which flew recently. It has a span of 19 ft. 6 in. and is powered by a 25 h.p. 1,135 c.c. Volkswagen engine. Consideration is being given to a scheme for fitting it with a Rollason RTW engine.

JAP FIRST.—The Fuji T1F2 which made its first flight at Utsonomiya, Japan, on January 19, has a Bristol Orpheus, and the limiting Mach number is 0.85. It is to become the standard trainer of the Japanese Air Self-Defence Force.

COMMERCIAL AVIATION AFFAIRS

B.E.A.-CAMBRIAN LINK.—A minority interest in Cambrian Airways has been acquired by B.E.A., who will be represented on the Cambrian board by Sir Arnold Overton and Mr. P. C. F. Lawton. In May, 1956, B.E.A. and Cambrian signed an operating agreement to integrate certain services; as a result, Cambrian now operates a twice-daily Cardiff-Bristol-Manchester service which acts as a feeder to B.E.A. Manchester operations, and B.E.A. represent Cambrian interests in Belfast, Liverpool, Manchester, Guernsey and Jersey.

BRITANNIA 312s FOR AFRICA.—After July, B.O.A.C. will be using long-range Britannia 312s on the London-Johannesburg route. On and after March 8, when the new Embakasi airport is opened, the 102s will call regularly at Nairobi instead of Entebbe.

EARNINGS DOWN.—In the year 1957 American Airlines earned a net profit of $10,866,000. This figure compares with $19,573,000 for 1956, though the 1957 revenue increased by nearly 5%.

NANDI PLANS.—Development of Nandi Airport, Fiji, as the main staging post on the air route between Honolulu and Australasia is to be completed by the end of 1959, according to plans announced in New Zealand. Details of the proposed developments were first printed in our issue of November 30, 1956; they include lengthening the main runway to 10,700 ft. and developing a new terminal area.

BACK TO CAIRO.—Qantas resumed their call at Cairo on the London-Sydney route on February 2, being the first of the British, French and Australian operators to use the airport since October, 1956. Karnak Travel Co. are acting as agents for Qantas and B.O.A.C. and servicing is being done by K.L.M.

DOPPLER FOR P.A.A.—The General Precision Laboratory's Radan Doppler navigator (see THE AEROPLANE, February 22, 1957, pp. 262-263) is to be standardized in Pan American Airways' fleets of Boeing 707s and DC-8s. As already recorded, P.A.A. have been testing this self-contained Doppler system in a DC-7C, which, so equipped, has now made 18 transatlantic crossings.

OTTERS FOR QANTAS.—Four de Havilland Otters have been purchased by Qantas Empire Airways for use on their internal routes in New Guinea. One, for delivery in May, will be equipped as an amphibian and, based at Port Moresby, will replace Beavers and Catalinas previously used. One Otter landplane will be based at Port Moresby and two at Lae.

FRIENDSHIP TOUR.—The Fokker F-27 PH-NVF returned to Schiphol on January 15 after flying 109 hours on its demonstration tour to India and through the Middle East. Among the most interesting flights were those made into and out of airstrips and airports in Kashmir, including Poonch (1,800 ft. long) and Lep (which, at an altitude of 11,544 ft., is one of the highest in the World). At Lep the F-27 took off at a weight of 34,320 lb. in 2,520 ft.

MANDATORY RECORDS. — The U.S. Civil Aeronautics Administration is to require all large transport aircraft operating above 25,000 ft. to carry flight-recording equipment after July 15 this year. Such recorders will, therefore, be mandatory equipment for the Boeing 707 and 720 series, the DC-8 and the Convair 880.

THE BELFAST ACCIDENT. — A public inquiry is to be held into the accident to a B.E.A. Viscount 802 at Nutts Corner Airport on October 23 last year. The date and place of the inquiry will be announced later.

MORE NEWS ITEMS ARE ON PAGE 217.

AIR TRANSPORT

Freedom of the Canadian Sky

A FUNDAMENTAL change in the Canadian Government's domestic air transport policy was announced last week-end by Mr. George Hees, the Transport Minister. In future, competition on domestic routes which are at present preserved for T.C.A. will be permitted, subject to Air Transport Board licence. Similarly, T.C.A. will be able to apply for licences to fly on routes monopolized in the past by C.P.A. and other privately owned operators.

International routes originating in Canada will also be open to all Canadian operators in the future. At present, T.C.A. has the monopoly of Canada-U.S. services, and T.C.A. and C.P.A. share the trans-ocean rights eastwards and westwards from Canada, without coming into direct competition.

In anticipation of this change of policy, C.P.A. applied some months ago for permission to fly passengers, freight and mail trans-continentally in Canada, without actually duplicating T.C.A. routes. This application is likely to be the first heard by the A.T.B. in the light of the new policy. The gradual licensing of C.P.A. and other operators to extend their services should provide a useful stimulus to air transport in Canada.

Off to Moscow

ON February 18, British European Airways are flying a Viscount 806 out to Moscow. This special flight—the first of several which are planned for the coming months—is being made primarily to take a joint M.T.C.A./B.E.A. technical team to Russia to continue talks which it is hoped will lead to the opening of a regular service by September.

The Ministry team is led by Mr. M. M. V. Custance, the under-secretary responsible for air services and civil aviation international relations. Others in the party are: Mr. G. W. Stallibrass, O.B.E., director, aerodromes technical; Mr. V. E. Canacho (aerodromes); Mr. M. J. Clayton (telecommunications); Mr. A. R. Kirk (air traffic control); Mr. W. Casley (Aeronautical Information Service); Mr. K. A. Porter (safety and regulatory); and Mr. G. E. Bell (noise measurement). B.E.A. is represented by nine officials, in addition to the flight crew which will be commanded by Capt. W. Baillie, chief flight manager. Other captains on board will be Capt. G. G. McLannahan, flight manager, Viscount 806s, and Capt. H. C. Bailey. The radio officer will be I. A. Dagleish, and the crew includes a flight engineer, two stewards and an interpreter.

The Viscount (G-AOYH, the third of 18 on order) is expected to fly by way of Copenhagen, which is the route B.E.A. would use for their regular service. It is scheduled to return on February 21. An agreement was signed in London on December 19 between the Russian and U.K. governments, for the establishment of reciprocal air services.

Visitor From Australia

DURING the first nine days of this month the Australian Minister of Civil Aviation (and, more important, perhaps, of Shipping and Transport), Senator Shane D. Paltridge, looked around the British aircraft industry with the idea of bringing up to date his knowledge of the civil aviation business. This visit was part of a general tour, taking in the major manufacturing units in the U.S., Britain, Holland and France, and including the formal signing, last Friday, of the first U.K.-Australia Air Transport Agreement.

In America, Senator Paltridge looked in at Boeing (whose 707s have been bought by Qantas), Douglas, Lockheed and Convair. In the U.K. he visited Vickers, de Havilland, Bristol, Rolls-Royce and Handley Page and discussed the Armstrong Whitworth 650 freighter. He flew in a Britannia 312 and in the H.P. Herald. In Europe he was due to see Fokker (whose F-27 has been ordered by T.A.A.) and Sud Aviation (their Caravelle is expected to be bought by T.A.A.).

At a Press conference on February 5, Senator Paltridge made it clear that his tour was primarily educational and that, with the time at his disposal, he could do no more than visit the major aircraft constructors and talk about the major projects. But he admitted, if only by inference, that Australia was just as interested in bush-type aircraft, designed to a modern formula, to replace the aircraft at present used on the uneconomic, small-traffic, but nevertheless essential services, and that sterling was easier than dollars.

Earlier in the week—on February 3—the High Commissioner, Sir Eric Harrison and Lady Harrison had been host and hostess at a reception at Australia House where people in British aviation business and Ministries could meet Senator and Mrs. Paltridge.

The Munich Accident

AS we went to press on February 10, the preliminary investigation had suggested that the take-off accident to B.E.A.'s Elizabethan, G-ALZU, at Munich on February 6 was probably caused by freezing of the snow and water on the wing—presumably following the delayed departure. The eventual findings must await the result of the official inquiry which, by international agreement, is made by the country in which an accident occurs unless otherwise requested by that country. In this case the inquiry is being made by the West German Ministry of Traffic and Transport.

The de-icing system of the Elizabethan is by heated air supplied by four combustion heaters—one for each outer-wing leading edge and two for the tailplane and fin leading edges. The propellers, engine intakes and panels in the windscreen are de-iced by means of electrically heated elements.

There were 23 survivors—15 of them, including the first officer, still in hospital as we went to press—out of a total complement of 38 passengers and six crew. The Elizabethan was on a charter flight to London, bringing back members of the Manchester United Football Club, sports writers and others from Belgrade, Yugoslavia. The same aircraft had taken the team out to Belgrade on February 3.

This was the first fatal accident to an Airspeed Ambassador/Elizabethan, of which B.E.A. originally had 20.

BRITANNIA FOR C.P.A.—The first of five Britannia 314s being built by Short Brothers and Harland for Canadian Pacific Airlines leaves Sydenham Airport, Belfast, for Filton where its test and acceptance flying will be completed.

CHANGE OF COLOUR.—One of the two Viscount 786s which have been sold to Lanica in Nicaragua; they were originally ordered, with a third 786, on behalf of Lloyd Aereo Colombiano. The latter company was unable to finance the deal, and has recently been declared bankrupt.

What is a "DC-3 Replacement"?

THERE appear to be a good many misunderstandings about the term "DC-3 replacement." So that our own occasional use of the words may not be misunderstood, we shall, here and now, give our definition of the term.

This definition covers any present or future civil aircraft which can do the work now being done by the DC-3—and which, preferably, can do it more efficiently.

All of us know that the DC-3, as such, was replaced, in terms of the use for which it was originally designed, nearly two decades ago. The first DC-3 order was, if we remember correctly, for a transcontinental "luxury" sleeper. Even its predecessor, the DC-2, was, in its day, very much a mainliner and, at the time of its success with K.L.M. in the England-Australia (or MacRobertson) race, was named in race reports by one well-known British newspaper (guess which) as the "Flying Hotel."

But there are still something like 2,000 DC-3s and C-46s at work in environments where neither ground facilities nor traffic-potentials permit the sensible use of their more modern successors. The youngest DC-3 (or C-47) is now more than a dozen years old; it is wearing out and spares are getting more expensive every year. Yet the market price of this remarkable aircraft still remains quite firm—and very high.

Who can cross his heart and say seriously that there is no future in the manufacture and sale of an aircraft which will do the DC-3's job—and do it better?

"Go-No-Go" Indications

IN a paper presented by an IFALPA representative at the ICAO Airworthiness Committee session in October-November, 1957, a number of suggestions were made about means by which pilots of future turbojet transports might be given more positive speed-distance information during the take-off.

It has been obvious for a long time that the present accepted method of using the airspeed readings as a means of determining the critical power-failure point during take-off (V_1) is seriously deficient—and may be dangerously deficient when the turbojet transports come into use in large numbers. Not only is acceleration-rate more critical with turbojets, but it is also more difficult to judge, and, with the use of off-loaded lift and high-torque brakes, it may be possible to use very high V_1 speeds in meeting the accelerate-stop distance.

The IFALPA suggestions for solving this problem are based on determining whether the build-up of take-off speed is normal—which is considered to be the most promising approach. Three possibilities suggested are as follow:

(1) Position markers along the runway to provide a reference point for the pilot during the first part of the take-off roll. These would be utilized together with a reference speed, which would be determined prior to the start of take-off from a chart which would take into account the relevant factors.

(2) An internal counter system operating from the wheel rotation could be utilized in a similar manner. The reference numbers for initial setting would be obtained from a similar chart and cranked into a "Veeder Counter" type of instrument prior to take-off. Such reference information would be checked against airspeed to determine if actual performance was meeting expected performance. Such a device could also be used for determining the critical power failure point.

(3) An instrument which combines the airspeed indicator with an accelerometer. This has received scientific development and is available if the demand makes production practicable. No additional instrument space is required as it is cased in the same housing as a present-day airspeed indicator and, when acceleration ceases, it functions as a normal accurate airspeed indicator. This method has one additional advantage in that it is constantly assessing the speed against the rate of acceleration and so also integrates the effect of other factors such as soft runways, low tyre pressure, and dragging brakes, as well as the usual factors affecting take-off

IRISH FRIENDSHIPS.—A recent picture of F.27 Friendship production in the Fokker works at Schiphol, showing the first two aircraft in final assembly. Both these are for Aer Lingus, who hope to take delivery in the autumn of the first of seven they have on order. Meanwhile, the first flight of the Fairchild F.27 is now expected in March.

The Projects and the Prospects

WHILE the politicians have been using the short-haul turbojet project as a means of cajoling the British aircraft industry, and the manufacturers seem to have been disagreeing about the relative importance of the B.E.A. egg and the World-market chicken—nobody has had much to say about the reasons why this project is considered to be a worthwhile one. The fact that it is so—subject to the hope that the U.S. industry will not get on to it too thoroughly and too soon—has simply been taken for granted.

Obviously—and assuming the by-no-means certain fact that the airlines have really decided to back the turbojet rather than the turboprop for all full-scale operations—the re-equipment spectrum has a big gap which is waiting to be filled. This gap could be filled by an aircraft which is smaller than the Boeing 720 and the Convair 880, has a more practical airfield, traffic pattern and airworthiness performance and offers a shape of cost-curve which will please short-medium-haul operators with plenty of heavy-traffic routes.

It is equally obvious that this is not the only equipment gap—so the company or consortium which does not succeed in getting the B.E.A. order, or which concludes that the project is rather on the ambitious side, can get going with something else. A so-called DC-3 replacement, for instance, out-Friendshipping the Friendship, could be marketed—or a fast, specialized, long-haul freighter. There is surely plenty to do in the way of civil aircraft.

But the short-haul turbojet transport does appear, at the moment, to offer the best chance for a consortium which is prepared to invest a lot of money and is determined and experienced enough to enter the big-time transport aircraft manufacturing and selling business.

The Battle is Already Joined

With the announcement of the Boeing 720 and of United Air Lines' useful order for it, we begin to see something of the struggle which may have to be fought by the British aircraft industry during the next three or four years if it is going to obtain a really strong foothold in this market.

Not that the Boeing 720 is a short-haul aircraft, or one that is in the same category as the Bristol 200 and D.H.121—but it is capable of doing the same kind of work, is a simple development of a known, existing aircraft and will be available to the airlines very much earlier. The battle seems already to be joined.

Rightly or wrongly it is being assumed that the short-medium-haul carriers will want an aircraft with a specialist performance and that the large all-purpose carriers will find it cheaper to diversify their fleets than to meet regional limitations by flying their long-haul aircraft at uneconomically low gross weights.

It is a fact that by far the largest number of World airline stages are well below the 1,000-mile mark and in the U.S., for instance, about 60% of air services are flown over stages under 200 miles. On the other side of the picture, however, many more than 1,000 flights are made in the U.S. every week over non-stop stages in excess of 1,000 miles, and on routes outside the U.S. there are probably at least an equal number of similarly long non-stop stages—a large number of them on routes with sectors which are considerably longer.

Certainly it seems that if B.E.A. is firmly in the market for such a specialized aircraft, then there must be other regional carriers who are similarly minded; and that if Pan American is toying with the idea of gauge-changing for its extension operations, then Trans World is likely to follow suit. It remains to be seen whether that mysterious giant, Pan American, is seriously interested in dealing with the British aircraft industry, or whether it is showing this interest partly in order to goad the U.S. industry into producing the kind of aircraft required for its European extensions and Caribbean services.

The question that has yet to be answered is: What formula for performance and capacity is likely to appeal to most customers?

There appear, broadly, to be two schools of thinking on this question. One says that airlines have always demanded from their aircraft longer ranges and bigger capacities than those originally envisaged; and they have always tried to use their aircraft for a wider range of duties—so we must always build in the elements for range/payload stretch and resist the temptation to produce a better aircraft for one customer at the risk of failing to satisfy the others. The other school says that the economic performance of transport aircraft has always been spoilt by attempts to please too many customers or prospective customers; this is a *short*-haul turbojet and nothing will be gained by trying to make it do a medium-haul job where it will, in any case, run into competition from the Boeing 720 and the Convair 880. In short, this school says, the time has come, for once, to be uncompromising and to concentrate on the business of making this particular aircraft the most attractive in the World to the operators for whom it is intended.

No one outside the tight Ministerial, manufacturing and airline groups knows anything much about the performances of the Bristol 200 and the D.H.121. The outline of the B.E.A. specification, published last year, required an aircraft which would carry a full payload over stages up to 1,000 miles, would cruise at about 600 m.p.h. and have a maximum capacity for 100 passengers. It must be supposed that both Bristol and de Havilland offered aircraft to B.E.A. with this order of performance—and with estimated operating costs to match this performance.

The figures issued for the Bristol 200 show a full-payload stage of 1,700 miles. Since you cannot carry fuel for 700 extra miles without some increase in structure-weight and, therefore, in estimated costs, it can only be imagined that the Bristol project had a built-in allowance for this improved range/payload performance and that Bristol had decided that World sales demanded a less restricted performance than that required by B.E.A.

On the other hand, it is difficult to believe that de Havilland, with their knowledge of average airline demands, would not, if necessary, have built in similar structural allowances for range-stretch before submitting their design or designs. Perhaps they did not consider it to be necessary and were of the opinion that the B.E.A. requirements, in addition to being the only firm requirements, were likely to be typical of those of the airlines with which the British aircraft industry had real chances of success.

A David or a Goliath?

Another important point to be considered in weighing the various aspects of the problem concerns the capacity of the British aircraft industry to deal with any "new" market which has a really big potential. If there is a large prospective market for the short-haul turbojet transport then most of the buyers will want these aircraft at more or less the same time—which means tooling for production at the rate of at least ten aircraft a month.

In terms of technical knowledge and available manpower, the British industry is obviously capable of doing this—but, with the knowledge that the U.S. industry will go hard for the biggest share of the same market, can we justify the financial risk involved? Perhaps it is better that we should continue to be a David rather than a Goliath and come into the market later with something very much better—but which, because the mass buyers have already been satisfied, does not need to be built quickly (and expensively) in very large numbers.

Meanwhile, none of us must be allowed to forget that talk of the Government's refusal to consider the possibility of "rescue operations" for the aircraft industry on any civil project is just about as unrealistic as the form of contract by which an airline ensures the delivery of a new aeroplane to a guaranteed specification. Just as the airline is (because it cannot get into any other manufacturer's customer-queue) committed long before delivery—so the Government (through B.E.A. in this case) is committed to any aircraft which has been ordered.

The Treasury may not, in these hard times, consider an airline to be much of an investment—but it will think twice if it believes that, in investing with a national airline, it is also investing in a national manufacturing and exporting industry. There can surely be no mystery about the way the Treasury is thinking.—H.A.T.

Problems of Air Traffic Control

For the fifteenth Brancker Memorial Lecture, delivered last Monday, February 10, Air Cdre. W. E. G. MANN, C.B., C.B.E., D.F.C., *chose as his subject "The Control of Air Traffic" and dealt with the origin, development and future requirements in this essential field. Air Cdre. Mann is Director-General of Navigational Services, M.T.C.A.*

WITH the era of large-scale turbojet transport operations less than two years away, no subject could be of greater importance than that of air traffic control. And since Sir Sefton himself made a most accurate forecast, 25 years ago, of the traffic control problems which would confront civil aviation, the subject was an apt one for the Brancker Memorial Lecture.

By way of a brief summary, it would probably be fair to say that Air Cdre. Mann, in his lecture, took a finally objective stand in giving the impression that air traffic control development could only be taken so far in a given time and that the aircraft manufacturers and their airline customers must either provide greater flexibility in their vehicles, or accept the economic consequences of some inevitable A.T.C. restrictions.

Towards the end of his survey of the future prospects Air Cdre. Mann remarked:

"In the past improvements in the performance of transport aircraft have been steady and generally matched by advances in the art of Air Traffic Control and in the methods of navigation and communication. The unassailable requirement is for safety in the air and to this end I feel that those who fly have been well served by the Air Traffic Control organization. Now with the introduction of turbine-powered high-speed aircraft in numbers we are all faced with new and more demanding requirements. . . .

"Some of the longer term technical problems will take time to solve and experimentation will be necessary to find the best solutions. It may seem straightforward to decide to use computors until it is remembered that an elaborate computor may cost more than £1,000,000 The most economic and efficient solution will be of great interest to the operators as it may well come about that they will be expected to contribute towards the cost of the ground organization of the future. . . .

"On the aircraft side I consider that, in the interests of safety, regularity and effective control, aircraft should be able to decelerate more rapidly and to cruise at common speeds in areas of dense traffic near major airports so that they can be easily fitted into rapid landing sequences.

"It would seem to me that in the past some aircraft have been designed and bought with perhaps the cost per seat mile as the dominating factor and with little regard to the vertical flight path and general conditions of flight necessary to achieve that figure. I suggest that an even closer examination of the tracks, heights and speeds over which aircraft may have to fly owing to traffic conditions of the future, is needed before large sums of money are invested in a particular type of aircraft with a less flexible performance than those now in service.

"Designers and operators of aircraft, together with the radio industry and Air Traffic Control authorities, are all concerned with these problems. Only with the closest co-operation will the best solutions be found. . . ."

Earlier in his discussion of future prospects, Air Cdre. Mann had given a graphic illustration of the kind of problems posed by the turbojet transport.

"To illustrate the impact of these jet aircraft and the difficulties that confront Air Traffic Control, let us consider the kind of flight plan the operator and captain would like to file. We will assume that the flight is from Central Europe to America. Without doubt the captain would want to follow an optimum economic path in both the horizontal and vertical planes, probably passing over other traffic centres while he is climbing at a rate which cannot be specified precisely, to a height which can only be indicated generally and through traffic which would not have taken off until after he was airborne. At some point he would wish to start his descent through traffic which departed from termini near his destination several hours after he left the ground in Europe. Although he would not wish to cruise at any fixed height he would require his flight path to be clear of all other traffic.

"Today no such flight plan could be given a safe clearance by Control and I doubt if it will ever be possible to do so. I trust that the operators of jet aircraft have taken account of this.

"The requirements of turbo-propeller aircraft fortunately are

PROBLEM IN THE AIR.—The Boeing 707 Jet Stratoliner, seen here on an early test flight, is one of the types of aeroplane which will soon be posing new problems of air traffic control. Air Cdre. Mann discusses some of the problems in the lecture reviewed here.

somewhat more flexible, but the question that must be faced is: can regular, safe and economic operations be carried out by aircraft with such rigid operating requirements, or should the designers of aircraft and engines be asked to provide aircraft with more flexible operating characteristics?"

In considering the future prospects, Air Cdre. Mann made it clear that, if more and faster traffic was to be absorbed by the system, there would need to be greater economy in the use of controlled airspace. Such economy would only be possible with better knowledge and more accurate prediction of traffic distribution. Such knowledge and prediction would demand improved navigational facilities, more frequent information and better meteorological forecasting. Even then there would, on long-haul flights, be inaccuracies and these could only be put right by adjustments to air speed.

The lecturer pointed to the obvious advantages of radar and suggested the construction of four long-range stations giving cover for the controlled airspace in the U.K. from heights of 5,000 ft. to at least 30,000 ft. With this there would be the essential introduction of aircraft transponder beacons.

If turbojet aircraft were to require greater vertical freedom, then horizontal separations would need to be reduced if the overall capacity of the system was to be maintained or increased. Such lateral reductions would only be possible with much improved navigation systems and Air Cdre. Mann mentioned the advantages of the Decca and Dectra systems and the value of self-contained Doppler as a supporting aid.

Electronic memory and computing devices were promising, but even when the information was provided it was difficult to see how this could be presented in a three-dimensional form for the control officer. It was evident that the computor, as such, could not replace the highly trained controller when any degree of judgment and improvisation was required. The answer to the extent to which automation could be introduced would need to be found and the form and type of data to be transmitted over the World's aeronautical communication systems must soon be standardized if full advantage is to be taken of the possibilities of electronic memory devices and computors.

Modern planning of runways systems provided turn-off points which would reduce runway occupancy time and permit a theoretical rate of 60 landings an hour—but this rate would always be limited by the time interval required for the control of the different types of aircraft on the approach. For this reason it would be helpful if all aircraft could fly at a common approach speed. The present minimum separation during the approach phase was five miles—reduced to three when a slow aircraft followed a faster one. With a standard approach speed of 120 knots, a bad-weather landing-rate of 24 aircraft per hour would be possible on a single runway. The aim should be for at least 40 landings an hour per runway.

However, the lecturer mentioned an important problem for the future—the probability that the wing-tip vortices of certain new aircraft would set up a dangerous turbulence which would persist for so long that approach separations might have to be increased. New aircraft with very high approach speeds would also demand the best possible visual guidance for the pilot during the critical final part of an approach and with such higher approach speeds the number of overshoots and diversions was likely to increase.

In the earlier part of his lecture Air Cdre. Mann had run through the history of Air Traffic Control and its development from the appointment of the first "Civil Aviation Traffic Officers" in 1923 and the introduction, 10 years later, of the first control zone, which was established at Croydon, and of the first inbound and outbound routeing channels in that year.

Safety and the "Manned Missiles"

THE problems which the performance of present-day military and civil aircraft are posing for airport owners and air traffic controllers can be gauged from a recent decision by the U.S. Aircraft Owners and Pilots Association to ask that the U.S.A.F.'s "Century Series" fighters (i.e., F-100 and upwards) should be barred from civil airports.

In an editorial in the February issue of *The AOPA Pilot* the Association puts the problem this way:—

"Military security prevents us from discussing in detail the performance characteristics of such contemporary jet fighters as the Lockheed F-104, Convair F-102, McDonnell F-101, Chance Vought F8U, and so on. Let's just estimate that such aircraft climb at rates like 50,000 ft./min. (about 570 m.p.h. straight up), and cruise as high as 1,000 m.p.h. (about 16.7 miles per minute). Descent rates and manœuvring speeds are of the same order.

"Just those figures alone leave no doubt in our minds but that these aircraft are physically unable to abide by the minimum standards of safety spelled out in the Civil Air Regulations. Consider: from the instant his wheels leave the ground, the pilot of such an aircraft can neither see nor avoid other aircraft. He's climbing almost straight up, so he can't see the more conventional types of aircraft flying all around him. And he's going straight up at a rate that makes it impossible for him even to see the underside of, say, a large transport airplane before flying right through it.

"If this seems fantastic, consider further. The Department of Defense, speaking for all the armed forces, has stated publicly that the 'Common System' of air traffic control and navigation must, by 1964, serve military aircraft with a level-flight speed of 3,200 m.p.h. (53.5 miles per minute, or a mile in every 1.12 seconds). By 1964, we're told, these aircraft will be changing altitude at rates as high as 100,000 ft./min. That's about 19 miles per minute, or 1,140 m.p.h. straight up! They've also told us that these aircraft will operate at altitudes as high as 100,000 ft., and at landing approach speeds as high as 230 m.p.h."

Earlier in this article, AOPA had explained that this decision had been reached with reluctance.

"For many years AOPA," the article said, "has frequently and vigorously taken the position that large public airports should be open for the use of all who fly, civil and military. We now must modify that position, specifically in the case of jet fighter aircraft of the order of the Air Force's 'Century Series' fighters. . . . The Navy also has similar fighters. It is not much of an over-simplification to say that this class of fighter becomes an unwarranted hazard in the airspace from the moment its wheels leave the runway until it rolls to a stop after landing."

The joint-user problem in which AOPA has participated is that at the Portland International Airport, Oregon. The U.S.A.F. proposes replacing the present fighters based there with Century Series fighters. After studying the characteristics of these aircraft, and listening to detailed descriptions of how they must be handled, it is AOPA's conviction that such aircraft must be barred from any joint-use civil airport. "These are no longer airplanes in the common definition of the term. They're manned missiles. And they must be treated exactly like missiles, rockets or bullets, and confined to a restricted 'firing range.' The Department of Defense must do this now, in the interest of general public safety."

This latest model of the Grumman Gulfstream twin-Dart executive, now under construction, shows several small changes, particularly around the engine nacelles and wing root. The Gulfstream prototype is due to fly in May.

Progress with the New Herald

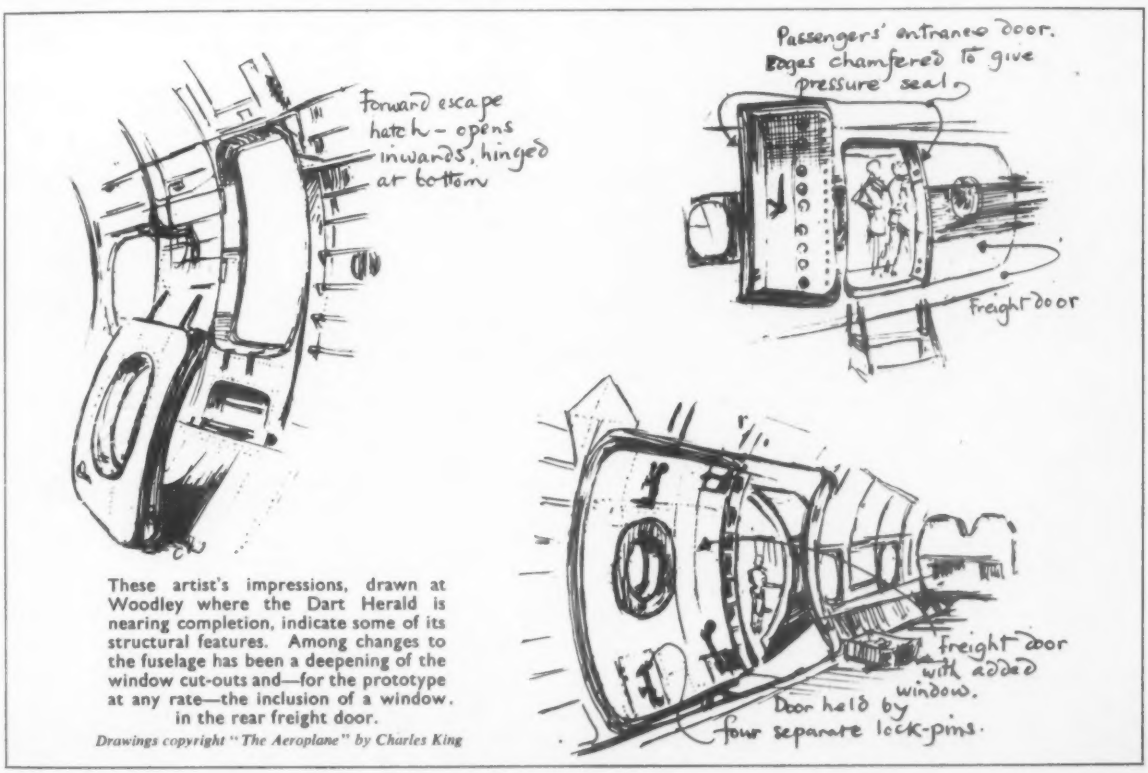
IN the very near future—if not by the time these words are read—the Handley Page Dart Herald is likely to emerge from the hangar at Woodley for its preliminary engine runs. All being well, by the end of the month, or early in March, it will make its first flight in the hands of the company's chief test pilot, Sqn. Ldr. H. G. Hazelden.

Readers will recall that this turboprop version of the original one with Leonides Major radials was announced by the company last May. It was explained then that a "popular demand" for such a turboprop aircraft for use on the short-haul routes in comparatively undeveloped areas had become very noticeable. For that reason the company felt that there was considerable promise in a new version of the Herald which could be offered to those operators who favoured the turboprop form of powerplant.

With such a proposition, the choice of the Dart as the powerplant was axiomatic. Quite apart from its being in the right sort of power bracket this engine has behind it an unrivalled history, for a turboprop, of successful airline service; and, moreover, it enjoys the world-wide after-sales service experience of the Rolls-Royce company. The engine selected for the Herald is, in fact, the R.Da.7 which delivers a take-off power of 2,100 e.h.p. compared with the 866 b.h.p. of the Leonides Major. In point of fact, the Dart installation forward of the firewalls is identical with that of the Viscount 810. The airscrews are four-bladed Rotol units having a diameter of 12 ft. 6 in.

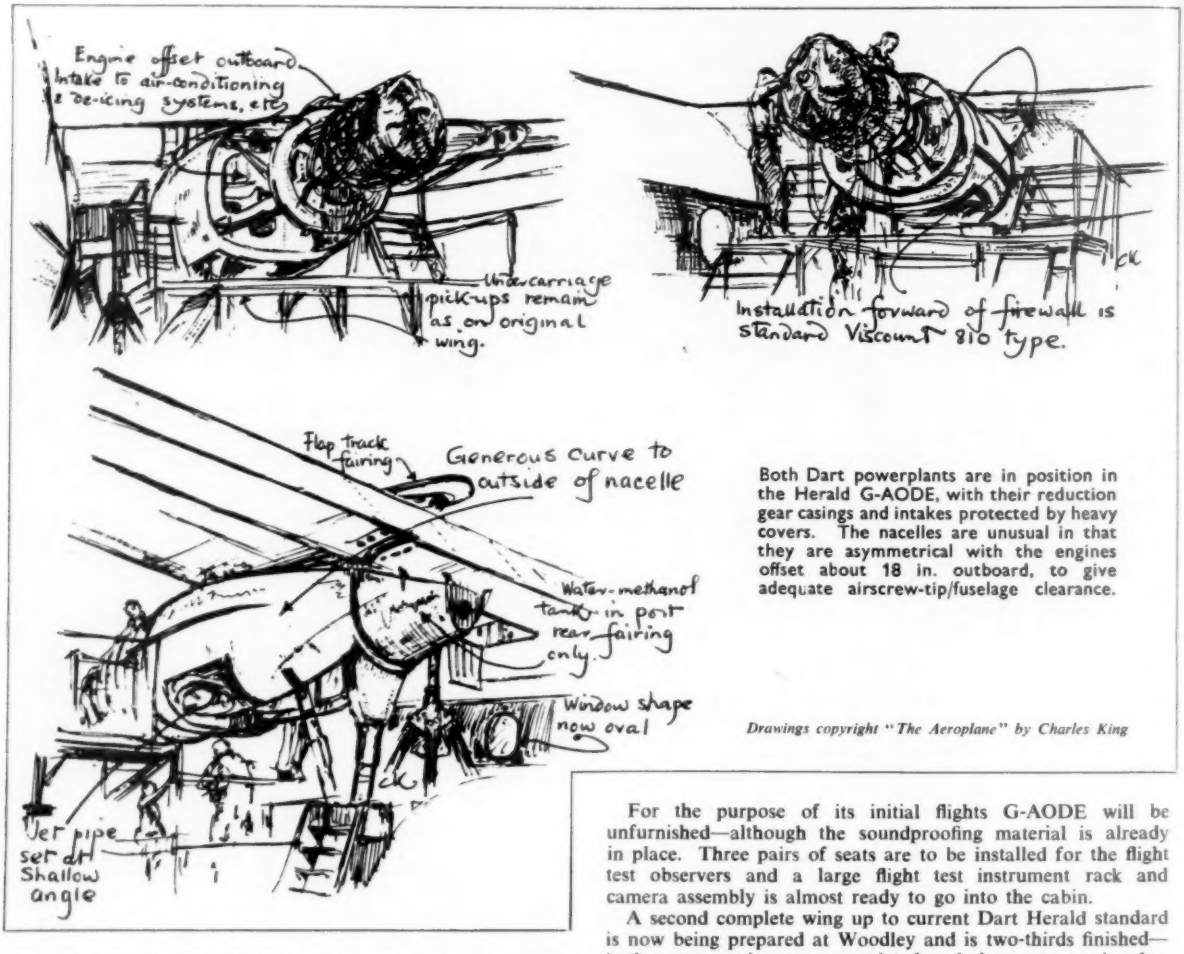
As would be expected, this transformation from four piston engines to two turboprops with a consequent increase in total power available for take-off from 3,464 b.h.p. to 4,200 e.h.p. has altered the basic performance of the aircraft by an appreciable amount. The cruising speed, for example, has risen from 211 m.p.h. at 10,000 ft. and an all-up weight of 37,500 lb. to 275 m.p.h. at 15,000 ft. and a lighter all-up weight of 37,000 lb. Here, perhaps, it should be pointed out that the lower installed weight of the two Darts has enabled the total fuel capacity to be increased from 700 to 1,000 Imp. gallons and also the gross weight to be reduced by 500 lb.

The still-air range with maximum payload has correspondingly risen from 265 st. miles to 692 st. miles. But on the debit


Forward escape hatch – opens inwards, hinged at bottom
Passengers' entrance door. Edges chamfered to give pressure seal
Freight door
Freight door with added window.
Door held by four separate lock-pins.

These artist's impressions, drawn at Woodley where the Dart Herald is nearing completion, indicate some of its structural features. Among changes to the fuselage has been a deepening of the window cut-outs and—for the prototype at any rate—the inclusion of a window in the rear freight door.

Drawings copyright "The Aeroplane" by Charles King


Engine offset outboard
Intake to air-conditioning & de-icing systems, etc.
Undercarriage pick-ups remain as on original wing.
Installation forward of firewall is standard Viscount 810 type.
Flap track fairing
Generous curve to outside of nacelle
Water-methanol tanks in port rear fairing only.
Window shape now oval
Jet pipe set at shallow angle

Both Dart powerplants are in position in the Herald G-AODE, with their reduction gear casings and intakes protected by heavy covers. The nacelles are unusual in that they are asymmetrical with the engines offset about 18 in. outboard, to give adequate airscrew-tip/fuselage clearance.

Drawings copyright "The Aeroplane" by Charles King

side, with two engines instead of four, there is an inevitable increase in the balanced field length required—this has, in fact, increased from 2,916 ft. to 3,660 ft. (both at I.S.A. sea-level conditions and maximum take-off weight). Despite the lower landing weight, which is the same as the take-off weight, the unfactored landing distance from 50 ft. remains much the same at 2,260 ft. because of the lower windmilling drag of the two airscrews and some residual thrust from the jetpipes.

The prototype Dart Herald has been derived from the prototype Leonides Major Herald G-AODE. Apart from the much altered engine powerplant installations the changes have included sundry local modifications to change the wing from a four-engined to a two-engined unit; the incorporation of integral fuel tanks outboard of the outer wing joint to provide the necessary extra-fuel capacity; and the insertion of a 20-in. bay in the front fuselage just forward of the centre section.

This last-named modification has served two important purposes. First it gives added fuselage volume for possible future high-density seating arrangements. Secondly it effectively moves the crew's entrance door ahead of the now further forward airscrew discs; with the original front fuselage and the Dart installation the plane of the airscrew would be just about level with the rear of the door.

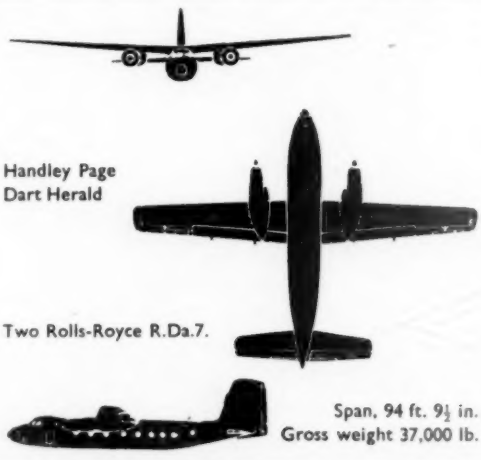
Other airframe changes that come in the category of overall refinements will not be made until production aircraft are on the line. Only the essentials and those that can be incorporated without holding up progress have gone into the prototype so that its first flight may be made as early as possible.

During a visit to Woodley last week we found the prototype Dart Herald well on the way to "roll out." The airframe was to all intents and purposes complete and was resplendent in a new colour scheme of white fuselage top; red window band "cheat line," and rudder; and a smart buff underside to the fuselage. Both engines were installed and were in the process of having their electrical and other services connected up.

For the purpose of its initial flights G-AODE will be unfurnished—although the soundproofing material is already in place. Three pairs of seats are to be installed for the flight test observers and a large flight test instrument rack and camera assembly is almost ready to go into the cabin.

A second complete wing up to current Dart Herald standard is now being prepared at Woodley and is two-thirds finished—both outer portions are completed and the centre-section has just been started. When this is finished this wing will go to the Handley Page structural test laboratory at Park Street for static wing tests.

A Herald fuselage—having the original length, but incorporating local structural changes and two windows of the new shape to make it representative of the Dart Herald—is nearing completion prior to being sent to R.A.E. Farnborough for the statutory 2P pressure test which will be done in the water tank there. When this test has been completed the R.A.E. will use the fuselage for a further research programme.



THE FIGHTING SERVICES

R.A.F. Regiment

AIR VICE-MARSHAL J. L. F. FULLER-GOOD, Commandant-General of the R.A.F. Regiment and Inspector of Ground Combat Training, is to leave the United Kingdom on February 18 for a 38-day tour of R.A.F. Regiment units of the Middle and Far East Air Forces, including the R.A.F. Regiment (Malaya). He will inspect units in Singapore, Hong Kong, Cyprus, Libya and Aden.

The Harris Cup, competed for annually in a weapons-training shoot between R.A.F. Regiment units of M.E.A.F., has been won for the second year running by No. 62 (Field) Squadron, based at R.A.F. El Adem, Libya. The cup was presented in 1954 by Air Cdre. J. H. Harris, then Senior Ground Defence Staff Officer at Headquarters at M.E.A.F., and now Director of Ground Defence at the Air Ministry.

Malayan Honours

IN the *London Gazette* for February 4, the Special Malayan Honours List for distinguished service during the period June 1 to August 30, 1957, the following awards are announced:—

Distinguished Flying Cross

Flt. Lt. G. G. Bayliss, R.N.Z.A.F., Flt. Lt. J. Davidson, Flt. Lt. L. J. Wittin-Hayden, Flg. Off. N. O. Leary, Flg. Off. D. Trainor.

Distinguished Flying Medal

Corporal S. Lidster, Royal Army Service Corps.

British Empire Medal (Military)

Flt. Sgt. D. R. Phinn, Sgt. P. J. Mulholland, Sgt. J. H. Packer.

Standard Presentation

NO. 33 SQUADRON is to receive its Standard from Air Chief Marshal Sir Philip B. Joubert de le Ferté, K.C.B., C.M.G., D.S.O., the first C.O. of the Squadron, at R.A.F. Leeming on April 17. To make it a fully representative occasion the present Squadron officers are sending an open invitation to all former members, and those interested in attending the ceremony are requested to contact the Squadron Adjutant at R.A.F. Leeming, Northallerton, Yorkshire.

The Story of "Treble One"

AN interesting and amusing account of the history of No. 111 Squadron from the early days of its formation in Palestine up to the present time has been written by Flg. Off. R. P. D. Sands. Well illustrated and giving details of the Squadron's commanding officers, bases and types of aircraft flown over the years, the book is available, price 10s., from the author at Bridge Farm, Friskney, Boston, Lincs.

Christmas Island Appointment

AIR COMMODORE J. F. ROULSTON, C.B.E., D.S.O., D.F.C., Director of Operational Requirements (A) at the Air Ministry since January, 1957, has been appointed Task Group Commander of the Reinforcement Party at the Christmas Island nuclear testing base. Previously a Deputy Director of Operational Requirements, Air Cdre. Roulston joined Headquarters, F.E.A.F., in 1953 and later took a course at the R.A.F. Flying College, Manby.

Group Captain C. M. Wight-Boycott, C.B.E., D.S.O., has succeeded Air Cdre. Roulston at the Air Ministry with the acting rank of Air Cdre. Senior Air Staff Officer of Air Headquarters, Malta, since 1955, Gp. Capt. Wight-Boycott commanded R.A.F. Colerne in 1952 and attended the R.A.F. Flying College in 1953.

No. 46 Squadron

NO. 46 SQUADRON will be holding its 41st consecutive Officers' Reunion Dinner this year at the Officers' Mess, Odiham, the Squadron's present base, on Saturday, April 12. All present and former officers of the Squadron, R.F.C. and R.A.F., are eligible to attend. Application should be made to the Commanding Officer, Wg. Cdr. H. E. White, D.F.C., A.F.C.

This record, believed to be unique to No. 46 Squadron, of 40 reunions to date, has been largely due to the enthusiasm and organization of Capt. C. J. Marchant, R.F.C., the first pilot ever to be posted to No. 46 Squadron. He announced his "retirement" from active organization at last year's dinner, but will be present as an honoured member this year and, all hope, for many years to come.

R.A.F. Appointments

THE following are among recent R.A.F. appointments:—

Wing Commanders: C. A. Alldis, D.F.C., A.F.C., to Headquarters, Bomber Command, as Chief Intelligence Officer; J. M. Ayshford, D.F.C., to Air Ministry for duty in the Department of the Chief of the Air Staff; J. M. Daniel, D.F.C., to Air Ministry, for duty in the Department of the Air Member for Personnel; J. P. Beale, to Allied Forces Northern Europe, for staff duties; J. A. Hunter, to Headquarters, Flying Training Command, for administrative staff duties; G. A. Martin, D.F.C., A.F.C., to R.A.F. Stradishall, to command No. 89 Squadron; A. D. Miller, to R.A.F. Scampton, for technical duties; A. C. Rawlinson, D.F.C., A.F.C., to R.A.F. Patrington, to command.

Squadron Leaders: G. M. Howard-Jones, D.F.C., to Air Ministry, for duty in the Department of the Air Member for Personnel (with the acting rank of Wg. Cdr.); R. A. N. McCready, O.B.E., to R.A.F. Seletar, for flying duties (with the acting rank of Wg. Cdr.); G. Packe, to R.A.F. Sutton-on-Hull, to command (with the acting rank of Wg. Cdr.).

Reunions

No. 44 Group.—The 10th officers' reunion dinner of Headquarters, No. 44 Group, Gloucester, and stations, will be held on March 14. Particulars from Mr. C. A. Riceman, Palm Court Hotel, Richmond, Surrey.

No. 1 S.F.T.S. (I) Ambala.—The 11th reunion will be held at the Chevrons Club, London, N.W.1, on March 15. Details from Mr. S. Booth, 28 Dene Road, New Southgate, London, N.11.

No. 194 Squadron.—The 8th reunion dinner will be held on March 15 in the Ballroom Suite, Victoria Coach Station, London, S.W.1. Tickets, price 18s. 6d., can be obtained from the Hon. Secretary, Mr. D. Williams, 63 Burnt Ash Hill, Lee, London, S.E.12.

MARINE CRAFT REDUCTION.—The number of R.A.F. high-speed launches operating on air/sea rescue duties around the coast of the United Kingdom is planned to be reduced in the near future as their rôle is taken over by helicopters. One of the bases to be disbanded is No. 1110 Marine Craft Unit at Immingham, near Grimsby.

Photograph copyright "The Aeroplane"

Photography's Indispensable Part

By Air Marshal Sir Robert Saundby

I CAME in contact with air photography at an early age, in a way that left a lasting impression on me. Nearly 42 years ago, in July, 1916, I was wounded and nearly shot down when escorting an F.E.2b., supposed to be engaged on the task of photographing German positions behind the Battle of the Somme. The fact that the F.E. had completely lost himself, and was some 20 miles farther east than he should have been, was the secondary cause of the incident. The primary cause was the need to supply 4th Army Headquarters with photographic intelligence about the enemy's dispositions.

In the First World War the Army regarded the Royal Flying Corps as having only two uses: in spotting the fire of artillery and reconnaissance, especially photographic reconnaissance. The General Staff's appetite for air photographs in those days was insatiable. They required a photographic cover almost daily of positions which had been occupied for months, if not years. While no doubt they learned a good deal from these photographs, they tended to overdo it.

After the War we recognized the importance of air photography by including it in the list of five specialist groups, in one of which all General Duties Officers were supposed to be trained. But we had many other worries, and we did not fully appreciate its scope and value, and no great amount of time and money had been devoted to the development of specialized aircraft or equipment for photographic reconnaissance. I think it is true to say that the Air Staff did not consider it practicable to send photo-reconnaissance aircraft deep into enemy territory in daylight. It was a remarkable Australian called Sidney Cotton who first drew our attention to what could be done in this way.

These reflections are stimulated by reading "Evidence in Camera," * by Flight Officer Constance Babington Smith, which is a fascinating story of photographic intelligence in the Second World War, written by one who herself did exceptionally fine work as a photographic interpreter.

We are introduced to Sidney Cotton, as is right and proper, at the very beginning of the book. He had served in the R.N.A.S. in 1914-18 and had invented, among other things, the Sidcot suit, which became the standard flying clothing in the R.A.F. Since then he had tried his hand at many things all over the World, and in 1938 he was here for the purpose of establishing business contacts, especially in Germany, for a colour-film company in which he was interested. In London he met Frederick Winterbotham, an Air Force officer with original ideas, who was at that time in the Intelligence Branch of the Air Staff. Winterbotham had been turning over in his mind a plan for secretly photographing important points in Germany from civil aircraft. Cotton was just the man for a job like this, and the scheme was given official blessing. A twin-engined Lockheed 12A was procured, registered in Cotton's name, and secretly fitted with hidden cameras. Painted a pale blue-green, so as to be almost invisible at high altitudes, this civil aircraft, piloted by Cotton, went about its lawful occasions, passing unobtrusively over many interesting areas. In this way a great number of photographs, not only of German places, but of Italian airfields and military installations in Libya, Sicily, Eritrea and Sardinia, were obtained.

I shall never forget my surprise, when I was let into the secret, and saw the magnificent photographs that Cotton had succeeded in taking. The Air Staff realized that there were new possibilities in high-altitude photo-reconnaissance which would have an immense value in the war we all knew was coming. Cotton's last job as a civilian was to take photographs of the German naval base at Wilhelmshaven a day or two before the outbreak of war.

When war came Cotton was put into uniform as a Wing Commander, and given the task of forming a Photographic Development Unit at Heston. The unit was directly controlled by the Air Ministry, and administered by Fighter Command. Cotton had *carte blanche* with regard to men, aircraft, and equipment, except that at first he could not get the Spitfires which he realized would be the right answer. But even Fighter Command at that time had very few indeed. Cotton got enough, however, to be able to show what could be done. Soon he was given two Spitfires, and from that time on the P.D.U. enjoyed top priority for aircraft and equipment.

Our cameras were not as good as they should have been for high-altitude work, but Wing Commander (later Group Captain) Victor Laws, surely the ablest and most distinguished photographic specialist the Air Force ever produced, soon brought about great improvements.

Bringing In Civilians

The growth of the interpretation side of air photography was equally unorthodox. The task of dealing with the greatly increased flow of prints from the P.D.U. soon swamped the small resources of the R.A.F. and some expansion was urgently needed. The manager of a firm called the Aircraft Operating Company at Wembley, which mainly carried on an air survey business, was Major H. Hemming, who had known Cotton since the early 'twenties. To him Cotton took his problem, and very soon Hemming's small team of skilled surveyors, equipped with modern apparatus for measuring and interpreting air photographs, was extracting a good deal more information than had been thought possible. Before long the Wembley factory was taken over by the Air Ministry and Sqn. Ldr. Peter Riddell, of Bomber Command Intelligence, was appointed to command the Photographic Interpretation Unit. Miss Babington Smith joined the P.I.U. at the beginning of 1941, and soon afterwards it moved to a large house near Marlow, which became the R.A.F. Station, Medmenham. Later it was expanded, by the addition of British Naval and Army Sections, and an American Section, into the Allied Central Interpretation Unit.

The P.D.U. and the P.I.U. had now grown into a very important branch of Air Intelligence, which was to have a radical influence on the conduct of air operations. In order to ensure its rapid expansion the Air Staff had given Cotton a free hand. In no other way could the rapid provision of the necessary manpower and equipment have been ensured, or the priorities fairly allocated between the insistent demands of the Navy, the Army, and the various Air Force Commands for air reconnaissance.

This arrangement had worked well, but had now outlived its usefulness. Cotton was a man of independent mind, naturally inventive and ingenious, who had a horror of "official channels" and always preferred to get what he wanted by unorthodox means. Such methods, no doubt, succeed up to a point, but sooner or later they antagonize the people who have been ignored or by-passed, and they end by producing chaos.

This is what happened to the P.D.U., and on June 17, 1940, it was placed under the administrative control of Coastal Command, and a regular officer, Wing Commander Geoffrey Tuttle, who had been Cotton's number two, was appointed to command it. The allocation of priorities for photographic reconnaissance remained in the hands of the Air Staff.

Although Cotton was thanked by the Air Council for his services and given an O.B.E. in January, 1941, I have always felt that the very great work he did in pioneering the development of high altitude photographic reconnaissance has never been adequately rewarded or even recognized.

It was during the critical days of the summer and autumn of 1940, when the Germans were concentrating on the defeat of the R.A.F. and the invasion of this country, that the P.D.U. demonstrated its value beyond all doubt and so laid the foundations for its subsequent vast expansion. The P.D.U. became the Photographic Reconnaissance Unit, moved from Heston to Benson, and eventually became a Group in its own right.

The interpretation unit at Medmenham also grew into a very large organization. Its work was divided into three phases. The first-phase reports, issued after a quick examination of the photographs, were concerned with the movements of ships and aircraft, rail and canal traffic, and an immediate appreciation of bomb damage. Second-phase reports, issued after 24 hours, dealt with general activity, and gave a co-ordinated view

* Chatto and Windus, 18s.

of what was happening. Third-phase reports, issued later, were detailed statements for specialist recipients.

When I went to Bomber Command in November, 1940, we had been trying to bomb a number of small military targets, mainly factories, oil plants and railway centres, selected by the Air Ministry. Although our aircrews took immense trouble to look for, and identify, these difficult targets, we had very grave doubts as to their ability to find them. The navigators and bomb-aimers were dazzled by searchlights, harassed by enemy fighters and A.A. fire, and misled by elaborate decoy fires and other methods of deception. The photographic interpreters certainly found evidence of bomb damage, some of it important, but it was mainly caused by a small percentage of successful attacks carried out under exceptionally good conditions. The majority of our attacks in average weather were obviously not finding these small targets.

The Flash-bomb Technique

The Command decided to ask the Air Ministry to equip every bomber with a suitable camera and to provide a flash-bomb, which could be dropped with the main salvo, and thus enable each bomb-aimer to photograph the ground beneath him at the moment of releasing his bombs. This demand was not at first well received, as it required some diversion of effort. It was, however, agreed to early in 1942.

At about this time Bomber Command set up its own P.R.U., No. 3, at Oakington. It was mainly for the purpose of bomb damage assessment, but it was also given the task of developing night photography by means of flash-bombs. After some eight months No. 3 P.R.U. was merged into the main unit at Benson.

Even when the flashlight photograph had been taken, however, it was no easy task to plot it successfully. Little by little the interpreters, prominent among whom was Flt. Lt. Bernard Babington Smith, the brother of the author of this book, became familiar with the characteristics of the various regions of North-West Europe.

As a result of our growing knowledge of the limited capabilities of our bomber crews over Germany at night, the Air Ministry abandoned the list of small targets, and allotted instead large industrial cities, and it was decided to give higher priority to the development of radar navigation and blind-bombing devices. To exploit these devices, which were not available in sufficient quantity to equip the whole Command, even if we could have trained all our crews to use them, we developed the Pathfinder technique, and set up a special force to find and mark the targets for the main body. When selecting aircrews for the Pathfinder Force, the evidence of flashlight photographs at the moment of bomb release was of great value.

The contribution, in almost every field of operations, made by photographic intelligence towards our final victory was immense. We could never have learned how to bomb by night—and by 1944 our night-bombing was at least as accurate as the Americans' day-bombing—without its aid. The Lords of the Admiralty, even with the help of "poppy and mandragora and all the drowsy syrups of the East" would never have had a night's sleep but for the perpetual watch kept by the P.R.U. on the movements of all German warships. We could not have so successfully cut Rommel's communications across the Mediterranean had it not been for the unfailing and timely information provided by photographic reconnaissance. We would never have been able to destroy the German communications in France and the Low Countries so completely in preparation for D-Day, had we not had such magnificent photographic cover, skilfully interpreted, to check our results.

But perhaps the most spectacular triumph of photographic intelligence is to be found in our battle against the "V" weapons. When rumours began to gather indicating that the Germans were preparing some secret weapon, the Air Ministry alerted the interpreters, and suggested that they should look out for three things—long-range guns, rocket aircraft, and rocket missile launching-sites. Intelligence sources pointed to Peenemünde, on the Baltic Coast, as a centre of some development of this kind. After a very careful search of all back covers of Peenemünde, Miss Babington Smith, who had early specialized in the recognition of enemy aircraft, and the interpretation of activities at German airfields and aircraft factories, found, at last, a tiny aircraft with a wing span of about 20 ft. This was, in fact, the first V.1 to be identified. But it was not until December 1, 1943, that more of these weapons were seen, and at last one was found on its ramp.

On May 5, 1944, a V.2 rocket was photographed on a trailer at Blizna in south-east Poland. After that, the interpreters knew what to look for, and a search of back covers of Peenemünde revealed a rocket standing on its fins. It had been reported as "a column 40 ft. high." So now we knew that we had two secret weapons to contend with, the pilotless flying-bomb and the ballistic rocket.

Meanwhile, an intensive photographic reconnaissance of northern France was put in hand, and soon discovered a number of new and ominous-looking works—the "ski" sites, most of which pointed towards London, though a few were aligned on Bristol and Plymouth, and some large concrete lay-outs, the purpose of which was obscure. Heavy attacks on these by tactical air forces, reinforced by British and American heavy bombers against the larger works, soon destroyed them all. The Germans began again, this time with simpler and more easily camouflaged catapult rails for the V.1, while they launched the V.2s from any bit of flat hard ground. Aided by photographic intelligence, our counter-attack was highly successful, and enormously reduced the scale of attack of both weapons. The Germans had planned to launch some 2,000 flying-bombs every 24 hours, but in fact only averaged about 100 in that period. The destruction of the huge concrete installations, served by rail, for the preparation and firing in quantity of V.2s, forcing the Germans to use road transport and improvised launching-sites, similarly reduced the scale of rocket attack on this country.

"Evidence in Camera" is a well-written and very interesting book that carries the reader from the days of Cotton and our early improvisations to the vast smooth-running organization at the end of the War, employing thousands of men and women. The daring and determination of the aircrews, who would hardly have turned a hair if asked for photographic cover of the Mouth of Hell, was matched by the skill of the interpreters, who could assess with amazing accuracy the present output of a damaged oil plant and how many days or weeks it would take to come back into full production.

Indeed, the story is so splendid and so creditable to all concerned that it is a pity that this book tends to give the impression, all too common in books about the War, that those responsible for running things were rather complacent and dim, until the civilians came along and showed them how.

One Mild Complaint

It is true that Cotton and Hemming did much to open the eyes of the Air Staff to the possibilities of modern techniques applied to photographic intelligence, but they were quick to see its value and to give it all possible support, at a time when great dangers threatened and nobody had enough of anything. If Cotton occasionally received a dusty answer, it was no doubt from some over-worked individual who was aggrieved at having his troubles increased as a result of Cotton's gift for short-circuiting normal procedures and getting the wires crossed. And if Bomber Command in the early days would not publicly admit that its results were disappointing, our night bombing was at least as good as that of the Germans. We must remember that it was the policy of the Government to build-up the story of our counter-attacks, in order to sustain the morale of our people in the face of enemy bombing, and it would hardly have encouraged our aircrews if they had come to believe that much of their effort was being wasted. We had to learn by experience, and the only practicable policy was to carry on as bravely as possible, while at the same time doing everything in our power to remedy the defects. The first essential was to find out what was happening, and in this photography played an indispensable part.

In the days before the War, when money was desperately short and everything was cut to the bone, the Air Ministry were hard put to it to provide the bare essentials for our security, and in this they did not fail.

Having registered this mild complaint against an otherwise excellent book, may I add that I hope that as many people as possible will read it. For, as Lord Tedder says in his foreword, it is "a story of British genius at its best, the genius which can weld into a perfect team a wide variety of highly individualistic individuals, and harness to the common cause their widely differing temperaments and skills while allowing full scope for their individual originality, enthusiasm and initiative. It is a story of imagination, devotion and courage whose contribution to the ultimate success of the Allied cause was quite incalculable."

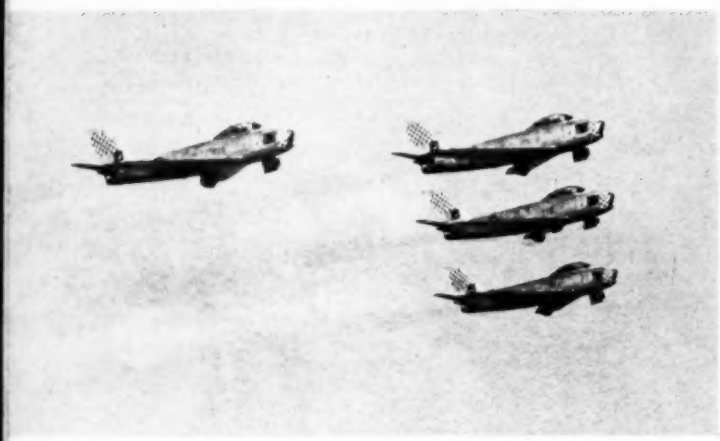
Pakistan Shows its Sabres

A LITTLE more than a year ago the Pakistan Air Force received its first North American Sabres, under the U.S. military aid programme, and its fighter squadrons have now completed their conversion to the F-86, via a smaller number of Lockheed T-33 jet trainers. The P.A.F. has reached a fully operational standard with its new equipment, and a remarkable demonstration of the fighting and flying efficiency of the Sabre squadrons was given at a display at Mauripur, Karachi, on February 2.

The occasion was the annual review of the Pakistan Air Force, which this year was performed by the King of Afghanistan, H.M. Mohammed Zahir Shah, and was also attended by the Commanders-in-Chief of the Iranian, Iraqi and Turkish air forces. These representatives of the Baghdad Pact comprised Maj.-Gen. H. Gilenshah, Imperial Iranian Air Force; Brig. K. Abbadi, Royal Iraqi Air Force and Lt.-Gen. Hamidullah Suphi Goker of the Turkish Air Force, accompanied by their aides and staffs. Among the other guests were representatives of the Royal Jordanian Air Force, some of whose personnel are at present training with the P.A.F.

The King of Afghanistan arrived in Pakistan in a Douglas DC-4 of Ariana, the Afghan airline, flown by a seconded P.A.A. captain, but on the morning of the air display he was flown the brief distance from Karachi airport to Mauripur in the P.A.F.'s Vickers Viscount, which is used solely for V.I.P. transport. He was accompanied by the President of Pakistan, and inspected a P.A.F. guard of honour before driving along t review the long line of Sabres, with the air and ground crews parked parallel with the runway. This was a most impressive line-up, of somewhere around 100 F-86s with a few T-33s, and stretched for nearly 2,000 yards down the sandy airfield, in front of 30,000 or so spectators. Normal attendance at this annual review, which is held at different airfields every year, is about 250,000, but public attendance was reduced this year by the early hour of the event (flying started at 09.25 hrs.), and the lack of special transport arrangements.

Right, the King of Afghanistan, H.M. Mohammed Zahir Shah, arriving for the display.



John Fricker

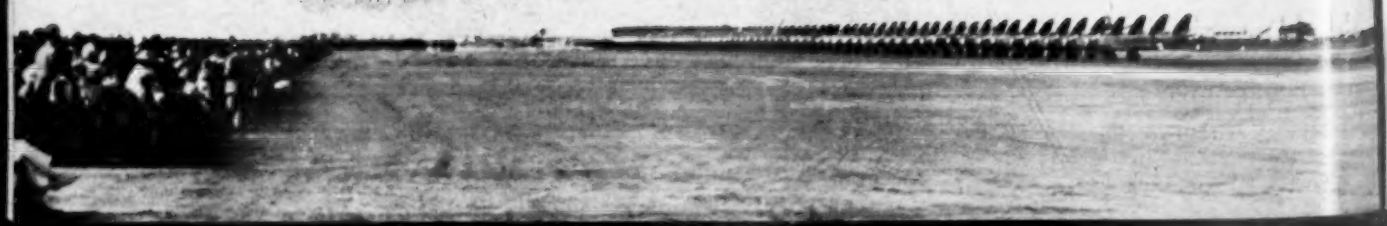
and

Photographer G. Moore

Report from

Mauripur

Photographs copyright "The Aeroplane"



An early start was essential to avoid the effects of the sun on the spectators, and to take advantage of the calm morning air. This was very desirable for the *pièce de résistance* of the P.A.F. flying display, which was a formation loop by no fewer than 16 Sabres, more jet aircraft, it is believed, than have previously flown together in aerobatic manœuvres. As it turned out, flying conditions were absolutely perfect, with excellent visibility, and no cloud, and the low morning sun behind the spectators. The highly competent ground organization provided a foretaste of the morning's flying performance, and precisely on the scheduled time four of the P.A.F.'s F-86Fs took off to climb up for a demonstration of sonic bangs.

As they traced a thin pattern of vapour trails in the upper air, where they were clearly visible with the naked eye, the long line of parked Sabres sprang into life as the aircraft began starting up and taxiing out one by one in clouds of dust to the far end of the airfield. The first few Sabres were then immediately over Mauripur at about 40,000 ft. and they next half-rolled in turn and plunged down, leaving their vapour trails behind them, in a transonic dive. By European standards

Air Vice-Marshal M. Asghar Khan, recently appointed C.-in-C. of the Pakistan Air Force.

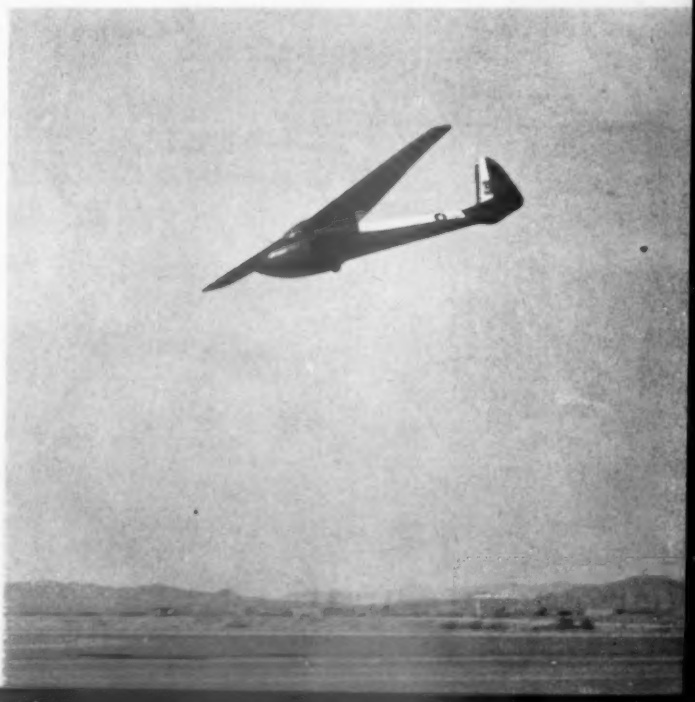
Above, the King of Afghanistan and distinguished guests with the President of Pakistan and the C.-in-C. Pakistan Air Force during a tour of inspection. Right, an Olympia sailplane flown by Flt. Lt. Salim Umar Khan.

it is most unusual to be able to see this manœuvre by transonic aircraft, and it became apparent how long the pressure waves take to reach the ground from the time lag after the Sabres had pulled out, high overhead. In due course, however, four very loud triple cracks reverberated over the airfield with satisfying accuracy.

After 17 Sabres had taken off in sections of four (plus one individual aircraft) a low fly-past was made by two F-86Fs towing gunnery flags which bore the flags of Pakistan and Afghanistan, and greetings to King Zahir Shah in his native tongue. The 16 Sabres of the "Falcon" aerobatic team, led by Wg. Cdr. M. Z. Masud, then came in at about 5,000 ft. to start their loop in diamond formation, which was maintained impeccably throughout the manœuvre. It was a highly accomplished feat of flying, completed with an efficiency equal to any air force in the World.

Seven Sabres broke away to continue group aerobatics, with several changes of formation, during which they pattern-flew the letter F, as the initial of their team. They were followed by a tightly packed 5-min. display of individual aerobatics by Sqn. Ldr. M. Khalid Khan, who is the younger brother of the recently appointed C.-in-C. of the Pakistan Air Force, Air Vice-Marshal M. Asghar Khan. Sqn. Ldr. Kahn opened his show with a sizzling low run at about 600 knots and some 50 ft. and continued with four- and eight-point rolls, an inverted fly-past and tight turns inside the airfield, before completing seven rolls on his final run in front of the spectators at low altitude.

Rapid contrasts followed with the take-off of an Olympia sailplane, towed by a P.A.F. Auster A.O.P. 6, half-a-minute before the return of the "Falcons," this time with four Sabres in tight box formation. Again led by Wg. Cdr. Masud, they



Though the sun is much hotter and the clothing of the crowd is different, public interest in the aeroplanes is as enthusiastic as at an R.A.F. display at home.

performed several formation changes with great precision and their flying was immaculate, but for perfection they might have positioned their manœuvres slightly closer to the spectators, and possibly at a lower height.

After the noisy return of the Sabres in a rapid stream landing, the glider aerobatics by Flt. Lt. Salim Umar Khan provided a refreshing pause before the noise and fury of the final demonstration. Twelve Sabres scrambled in a welter of dust and black J47-smoke to attack several ground targets in the centre of the airfield, the first four employing their six 0.5-in. Browning guns after two runs each, leaving a satisfying fire from their incendiary ammunition. Having established confidence in their marksmanship among the spectators, who were seated within a few hundred yards of the ground targets, the next six Sabres then peeled off into a succession of steep dives for rocket attacks, with live warheads, against the next group of marker screens.

Each of these F-86Fs was carrying four pods under each wing, housing a total of 56 2.25-in. Mighty Mouse folding-fin rockets per aircraft. These were released in rippling streams and streaked earthwards almost faster than the eye could follow. The sand all around the targets boiled up in a staccato series of shattering explosions, and a vast cloud of dust and smoke drifted slowly across the airfield (unfortunately, over the V.I.P. enclosure) after their attacks.

The final display of P.A.F. power was provided by two Sabres, which streaked very low across the airfield, parallel with the spectators, and each dropped two napalm tanks, to envelop the last target in a blazing mass of jellied petroleum. The crimson flowers that suddenly blossomed in the desert were followed by ugly clouds of black smoke, and the fleeing Sabres were pursued, fortunately unavailingly, by flaming fragments of napalm tank. This last, and most impressive demonstration, confirmed not only that the Sabre is still a highly effective ground-attack weapon but also that the Pakistani pilots are extremely skilful in its use.

Above, left and right, interior and exterior of the DC-4 in which the King of Afghanistan arrived flown by a seconded captain of P.A.A. Left, the P.A.F. Viscount in which Zahir Shah was flown from Karachi to Mauripur.

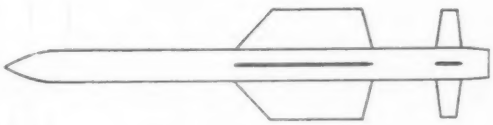
Photographs copyright "The Aeroplane"

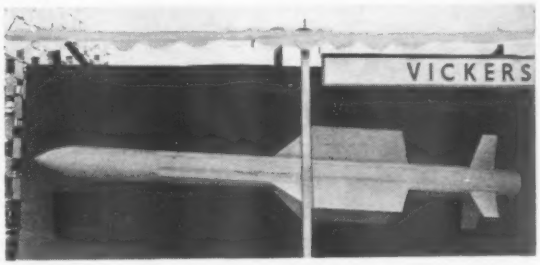
THE AEROPLANE

GUIDED WEAPONS DATA SHEETS

Another eight in our copyright series of guided missile data sheets are given on this and the following two pages. The first sets appeared in THE AEROPLANE for December 6, 1957, and January 3 last, when it was explained that the contents of the tables are based on published data from a number of sources and arranged in a standardized form to give the maximum amount of information. In this present set, as in the case of the previous tabulations, there are inevitably some gaps as a result of security restrictions or unreliability of published data. These omissions will be made good, as and when the information becomes available, in the form of revised sheets. Further sets of these sheets, which have been compiled by MR. D. HOWE, D.C.Ae., A.M.I.Mech.E., A.F.R.Ae.S., will be published in THE AEROPLANE at regular intervals.

Throughout the tables the following abbreviations have been used:—A-A=air-to-air, A-S=air-to-surface, A-U=air-to-underwater, S-A=surface-to-air, S-S=surface-to-surface, S.R.=solid rocket, L.R.=liquid rocket, T.J.=turbojet, R.J.=ramjet.





TYPE 888	A-A	GREAT BRITAIN
Design/manufacture *Vickers-Armstrongs/Vickers-Armstrongs*		**Service**

Guidance:
Control: *Moving Fins.*
Warhead:

Main Power:
One S.R. THRUST: *lb.* DURATION: *sec.*
FUEL: OXIDANT: — .

Boost Power:
None. THRUST: — *lb. for* — *sec.*

Weights:
MISSILE: *lb.* WEIGHT BOOSTED: — *lb.* PAYLOAD: *lb.*

Dimensions:
LENGTH: *16.08 ft.* MAX. DIA.: *1.04 ft.* WING SPAN: *3.75 ft.*
FIN SPAN: *3.75 ft.*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: HEIGHT: *ft.* RANGE:

REMARKS:
For all-weather interception.
Originally intended for use on thin-wing Javelin.
Project cancelled June, 1957. Fired from Canberras.

MATRA (M051)	A-A	FRANCE
Design/manufacture *Matra/Matra*		**Service**

Guidance: *Optical (passive homing).*
Control: *Foreplane and central rear fin.*
Warhead:

Main Power:
Two-stage S.R THRUST: *lb.* DURATION: *sec.*
FUEL: OXIDANT: — .

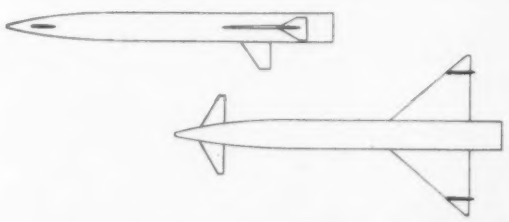
Boost Power.
None. THRUST: — *lb. for* — *sec.*

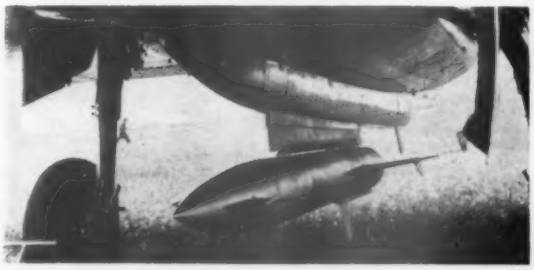
Weights:
MISSILE: *350 lb.* WEIGHT BOOSTED: — *lb.* PAYLOAD: *66 lb.*

Dimensions:
LENGTH: *10.0 ft.* MAX. DIA.: *1.05 ft.* WING SPAN: *3.3 ft.*
FIN SPAN: *1.7 ft.*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: *M=1.5.* HEIGHT: *50,000 ft.* RANGE: *8,800 yd.*

REMARKS:
Launched from Meteor, Vautour.
Numerous versions in existence.
Uses proximity fuse.





THE AEROPLANE
GUIDED WEAPONS DATA SHEETS

AEROBEE | RESEARCH | U.S.A.

Design/manufacture
Aerojet General/Aerojet, Douglas

Service
U.S.A.F., U.S. Army, U.S.Navy

Guidance: *None.*
Control: *None.*
Warhead: *None.*

Main Power:
One L.R. THRUST: *2,600–4,000 lb.* DURATION: *45 sec.*
FUEL: *Aniline.* OXIDANT: *Fuming nitric acid.*

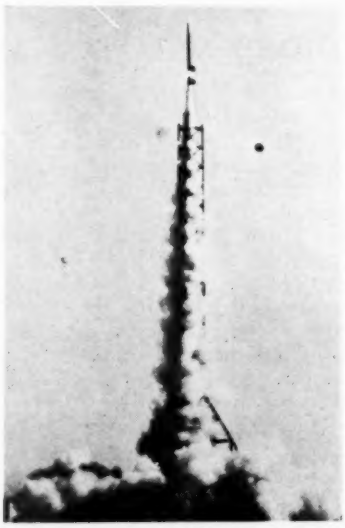
Boost Power:
Tandem S.R. THRUST: *1,800 lb. for 2.5 sec.*

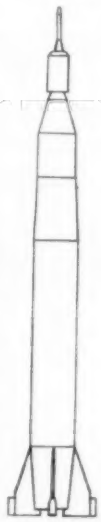
Weights:
MISSILE: *1,140 lb.* WEIGHT BOOSTED: *1,690 lb.* PAYLOAD: *150 lb.*

Dimensions:
LENGTH: *20.1 ft.* MAX. DIA.: *1.25 ft.* WING SPAN: — *ft.*
FIN SPAN: *5.1 ft.*
BOOST LENGTH: *5.75 ft.* BOOST DIA.: *1.0 ft.* BOOST SPAN: *5.1 ft.*

Performance:
SPEED: *M=4.0.* HEIGHT: *40 miles.* RANGE: — .

REMARKS:
Launched from 150-ft. tower. Helium fuel feed. Operational.





JUPITER C "EXPLORER" | RESEARCH | U.S.A.

Design/manufacture
U.S. Army Missile Dev. Centre/Chrysler

Service
U.S. Army

Guidance : *Inertial.*
Control : *Fin trailing edge (in rocket exhaust).*
Warhead : *None.*

Main Power :
S.R.* THRUST : *lb.* DURATION : *sec.*
FUEL : OXIDANT : —

Boost Power :
L.R.† (Based on Redstone). THRUST : *83,000 lb. for 150 sec.*

Weights :
MISSILE : *lb.* WEIGHT BOOSTED : *65,000 lb.* PAYLOAD : *31.0‡ lb.*

Dimensions :
LENGTH : *70.0 ft.* MAX. DIA.: *6.0 ft.* WING SPAN : *12.0 ft.*
FIN SPAN : *ft.*
BOOST LENGTH : — *ft.* BOOST DIA.: — *ft.* BOOST SPAN : — *ft.*

Performance :
SPEED : *M=25‡.* HEIGHT : *1,000 miles (mean)‡.* RANGE : — .

REMARKS :
* 2nd stage is S.R. cluster. Final (Satellite) stage is single S.R. † Uses Hydyne fuel. ‡ Satellite values—Satellite length 6.7 ft., dia. 0.5 ft., carries 11 lb. of instruments.

SKYLARK | RESEARCH | GREAT BRITAIN

Design/manufacture
R.A.E./R.A.E.

Service

Guidance: *None.*
Control: *None.*
Warhead: *None.*

Main Power:
One S.R. (Raven). THRUST: *11,000 lb.* DURATION: *35 sec.*
FUEL: . OXIDANT: — .

Boost Power:
None. THRUST: — *lb. for* — *sec.*

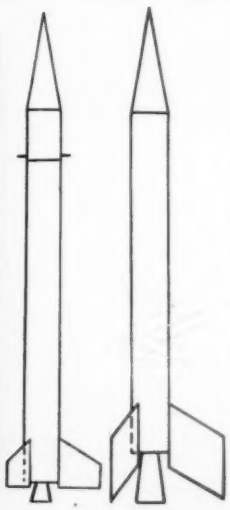
Weights:
MISSILE: *2,560 lb.* WEIGHT BOOSTED: — *lb.* PAYLOAD: *100 lb.*

Dimensions:
LENGTH: *25.7 ft.** MAX. DIA.: *1.47 ft.* WING SPAN: — *ft.*
FIN SPAN: *7.25 ft.†*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: *M=5.0.* HEIGHT: *76 miles* Range: — .

REMARKS:
For atmosphere research. Launched from 80-ft. tower. Will eventually be boosted (126 miles). Operational.

* Max. † Early version.



Later version ↑ Early version

THE AEROPLANE
GUIDED WEAPONS DATA SHEETS

VANGUARD (EARTH SATELLITE) — RESEARCH — U.S.A.

Design/manufacture: *Martin/Martin, Aerojet General, Grand Central*
Service: *U.S.N.*

Guidance: *Inertial.*
Control: *1st and 2nd stage, tilting motor. Roll control by rockets.*
Warhead: *None.*

Main Power:
*One L.R.** THRUST: *lb.* DURATION: *sec.*
FUEL: *Dim. hydrazine.* OXIDANT: *Fuming nitric acid.*

Boost Power:
One L.R. (based on Viking). THRUST: *lb. for sec.*

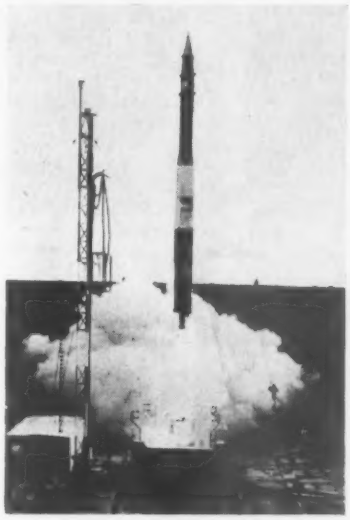
Weights:
MISSILE: *lb.* WEIGHT BOOSTED: *22,000 lb.* PAYLOAD: *24 lb.*

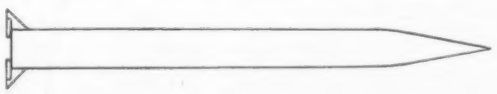
Dimensions:
LENGTH: *72.0 ft.* MAX. DIA.: *3.75 ft.*† WING SPAN: — *ft.*
FIN SPAN: — *ft.*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

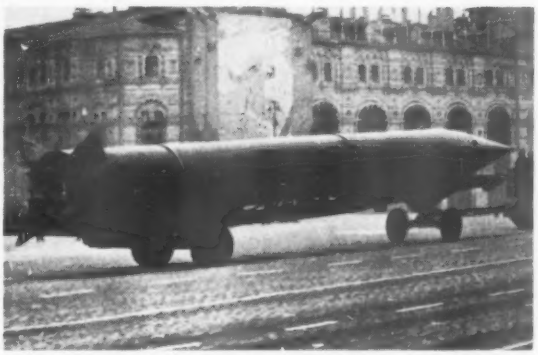
Performance:
SPEED: *M=25.* HEIGHT: *300 miles.*‡ RANGE: — .

REMARKS:
Photograph shows test firing.

* 2nd stage—3rd stage is solid rocket. † 2nd stage dia.=2.7 ft.
‡ Orbit height of satellite.







M 103 (T2) — S-S — RUSSIA

Design/Manufacture
Service: *Army*

Guidance:
Control: *Fin trailing edge and rocket exhaust vanes.*
Warhead:

Main Power:
One L.R. THRUST: *77,000 lb.* DURATION: *sec.*
FUEL: . OXIDANT: .

Boost Power:
None. THRUST: — *lb. for* — *sec.*

Weights:
MISSILE: *50,000 lb.** WEIGHT BOOSTED: — *lb.* PAYLOAD: *lb.*

Dimensions:
LENGTH: *67.0 ft.** MAX. DIA.: *5.3 ft.** WING SPAN: *11.0 ft.**
FIN SPAN: — *ft.*
BOOST LENGTH: — *ft.* BOOST DIA. — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: . HEIGHT: *ft.* RANGE: *400 miles.*

REMARKS

* Estimated.

HONEST JOHN (M-31) — S-S — U.S.A.

Design/manufacture: *Douglas/Douglas*
Service: *U.S. Army*

Guidance: *None.*
Control: *None.*
Warhead: *Nuclear.*

Main Powe: :
One S.R. THRUST: *lb.* DURATION: *sec.*
FUEL: *Hercules.* OXIDANT: — .

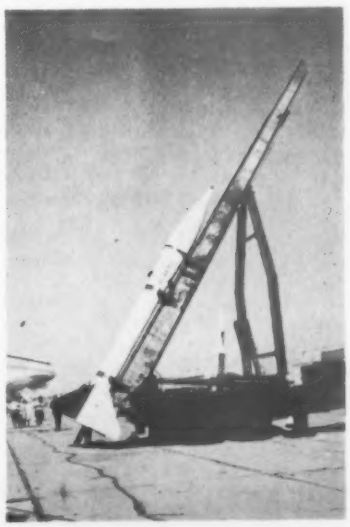
Boost Power:
None. THRUST: — *lb. for* — *sec.*

Weights:
MISSILE: *6,000 lb.* WEIGHT BOOSTED: — *lb.* PAYLOAD: *1,500 lb.*

Dimensions:
LENGTH: *27.2 ft.* MAX. DIA.: *2.5 ft.* WING SPAN: — *ft.*
FIN SPAN: *8.0 ft.*
BOOST LENGTH: — *ft.* BOOST DIA.: — *ft.* BOOST SPAN: — *ft.*

Performance:
SPEED: *M=2.0.* HEIGHT: *30,000 ft.* RANGE: *15 miles.*

REMARKS:
Operational.



An Untimely Retirement

AT THE relatively early age of 58 Mr. Louis Massey Hilton, D.F.C., A.F.C., A.F.R.Ae.S., has, on medical advice, retired from the board of directors of the Fairey Aviation Co., Ltd.

He went to the Fairey company in 1931, when he was aged 32, but then already had 14 years' experience of flying. After education at Sedbergh, he joined the R.N.A.S. in 1917 and learnt to fly on a Farman Longhorn. Tuition methods in those days were still somewhat elementary, and he flew his first solo after only 80 minutes' instruction. His duties in the First World War included anti-Zeppelin work with the Grand Fleet, flying Sopwith Camels from the small flight decks built over the forward turrets of cruisers.

He was transferred to the R.A.F. when the R.F.C. and R.N.A.S. merged in 1918, and after the War, in 1919, accompanied the North Russian Relief Force, sailing in the seaplane carrier H.M.S. "Pegasus." It was while flying Fairey IIICs and Short seaplanes at this period that he gained his D.F.C.

He remained on R.A.F. sea-flying until 1927, and did much useful experimental flying from the first aircraft carriers built specifically as such, instead of the converted cruisers which had hitherto served. This work involved flying floatplanes on to the steel decks of the carriers, and landing-on in the Fairey Fox, which was a two-seat day bomber as fast as contemporary fighters.

In 1927 Massey Hilton was posted as Air Staff Officer with H.Q. Coastal Area, and in 1930 became a flight commander in No. 41 (Fighter) Squadron, then flying Siskins.

His appointment to the Fairey company came about through an earlier association with Maj. Maurice Wright, then a director of the company, who had been an Air Ministry test pilot at Felixstowe when Massey Hilton, then a Flt. Lt., was also there.

Three years after joining Faireys, in 1934, Massey Hilton was appointed to the board, and from 1939 to 1941, when he was technical director, was responsible for adapting two different Naval Admiralty specifications for one aircraft—the Firefly monoplane—to meet both requirements.

At the end of the Second World War he was largely instrumental in founding Fairey's Australian and Canadian subsidiaries. In 1951 he was appointed assistant managing director, a position which he held until forced to relinquish it through increasing ill health.

The Revival of P.Z.L.

SOME details about the re-emergence of the Polish name of P.Z.L., reference to which was made in THE AEROPLANE of August 23, 1957, have recently become available.

Until the latter part of last year the Instytut Lotnictwa, or Aeronautical Institute, was the only official body in Poland which dealt with theoretical and experimental aspects of aviation, but it was recently revealed in Warsaw, by the director, Mr. Jan Staszek, that a major change has taken place about the part to be played by the Institute. The I.L. produced several aircraft prototypes, including helicopters, in recent years, and the first aero-engine of Polish design to be produced since the War, but as a result of criticism it was decided that design initiative should originate from a wider circle of aviation technicians in the industry.

On December 1, 1957, the Institute's design department was closed down and it has emerged as the Aviation Design Centre (Osrodek Konstrukcji Lotniczych), which acts as a consultant body for the design offices set up by the various aircraft works. The new designs being developed by the Centre will appear under the name of P.Z.L., which initials formerly stood for Panstwowe Zaklady Lotnicze, or National Aircraft Establishment.

R.Ae.S. Discusses Noise

AIRCRAFT NOISE can be judged by the vigour of public reaction to it. American experience on these lines was described by PROFESSOR E. J. RICHARDS of Southampton University in a lecture before the London Airport Branch of the Royal Aeronautical Society on February 5.

Professor Richards showed how the Americans have related noise intensity in decibels to public indignation. As noise increased the reaction ranged from mild annoyance through mild complaints, strong complaints and legal threats to vigorous legal action. Reaction curves could be corrected for frequency of occurrence; a noise which happened only once a day had an acceptable intensity 20 decibels higher than one which was heard every minute.

Experience in Britain indicated that the public reaction to noise was less intense than in America. In general, noise levels tended to be 10 decibels higher than those in America before there was an equivalent public response.

Professor Richards showed how this problem had grown by comparing the noise levels of a DC-3 and a B-47 with afterburner. The DC-3 noise interfered with speech over a distance of a mile in line with the runway; with the B-47 the distance was 12 miles.

The noise problem with jet aircraft had become intense because the sound emitted by a turbojet engine increased both with its power and with the exit velocity. The sound varied as the eighth power of the velocity and power with the cube of velocity. Thus for engines of equal power the noise varied as the fifth power of jet velocity. In a choked jet even more noise was produced when turbulence eddies passed through the shock diamonds in the jet stream.

This explained the approach in sound reduction, which was to reduce jet velocity. At the design stage of an engine this could be done by adopting the ducted-fan or by-pass technique.

With existing engines special nozzles could be used to reduce the jet velocity as rapidly as possible and to speed its mixing with the surrounding air. These nozzles could only be developed on a "suck it and see" basis; a noise reduction of 10 decibels was the most that could be achieved. A variety of these jet nozzles had been tested and developed by Rolls-Royce and Boeing.

Jet noise could also be reduced if the jet was emitted through a relatively narrow slot such as an annular nozzle or jet flap. This increased the proportion of high-frequency noise produced; noise of this type was more readily attenuated in the atmosphere.

Penalties were paid for noise reduction. Professor Richards showed a series of Boeing nozzles which had been tested; they increased the external drag of the aircraft from ¼% to 7%. In addition, nozzle silencers reduced engine thrust by 1-2% and the critical Mach number of an aircraft equipped with them was likely to be affected, particularly if it had a podded engine installation.

In the discussion mention was made of the immense structural difficulties involved in driving helicopter blades by means of a thin jet through the blade trailing edges. Professor Richards admitted this, but asked that the long-haired people should be allowed their dreams; one of his was a helicopter with blades driven on the jet-flap principle and controlled by means of cyclic variations in thrust.

MR. B. S. SHENSTONE, chief engineer of B.E.A., mentioned that in his view the Comet 2E now operating from London Airport was less noisy than the Comet 1, although its thrust was double that of the earlier aircraft. He thought that the main reason was that it climbed more steeply than the Comet 1. This steepness of climb would apply to the new B.E.A. jet aircraft and help to reduce the noise problem with them.

Another speaker gave details about the noise reduction with the special jet nozzles on the Comet 2E. He said that the actual reduction achieved was three to five decibels against the seven decibels claimed. Operating experience showed that there was an increase of 2-3% in fuel consumption with these nozzles.

Rotax at Hemel Hempstead

IN ADDITION to the company's head office and works at Willesden Junction in north-west London, Rotax, Ltd., aircraft electrical systems manufacturing concern, has in recent years expanded to the "new town" of Hemel Hempstead. Consisting of production, servicing and test facilities, this latest establishment is capable of manufacturing the complete range of AC and DC generators, invertors and motors, linear and rotary actuators, and other electrical components marketed by Rotax for aeronautical applications.

The plant has one large building which houses the complete production floor, management, control and design offices, and a second, smaller, building at the rear containing the power house, environment test plants and the generator test house. These facilities consist of a cold chamber operating at sea-level pressure, a high-altitude chamber for simulating reduced pressure and temperature conditions, and an electrical layout for complete aircraft-generator system testing.

Well lit by strip lighting and large windows, the production area is laid out as one continuous shop without any large partitions or dividing walls. The various manufacturing, assembly and test sections are separated by a number of gangways. Each section is made the domain of one foreman, who is responsible for the production and discipline of the personnel under his control.

With the exception of one section specializing in the manufacture of special components and operating on a two-shift system, all sections are designed to deal with one particular process or operation. The components under manufacture are

Top, a general view of the production floor from the offices at the front of the main building. Left, the high-altitude test chamber and, below, the control and instrument consoles for checking aircraft electrical systems in the generator test house.

Photographs copyright "The Aeroplane"

moved from one section to the next via the stores department running the length of the right-hand wall of the building.

Based on the "batch" production principle with a normal minimum of 20 units of any one particular component, as opposed to the mass-production system, the work progresses during manufacture from the front to the back, and right, of the factory floor. By patrol and final-view inspection techniques, all components and parts are checked and passed before going into the store for distribution for the next operation or final assembly. The overall ratio of operators to inspectors is approximately four to one.

Divided by two main gangways running the full depth of the production shop, the front three areas comprise the special-components section and the apprentice training school. Behind these on the right are the light, medium and heavy capstans; in the centre are the milling and drilling machine sections, and to the left is the heat-treatment department.

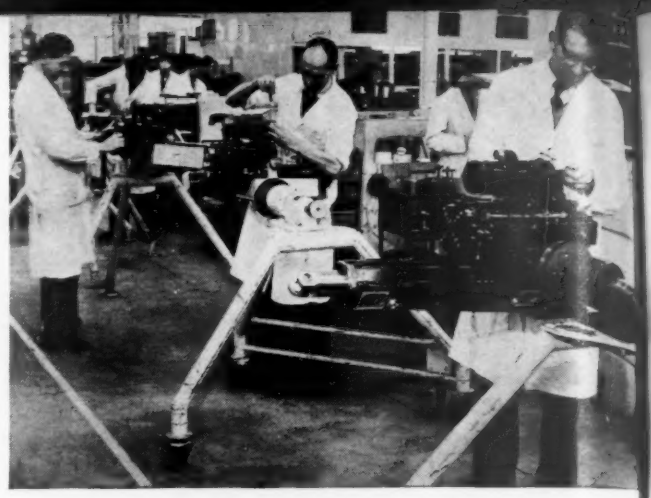
The third row from the front contains the operators and inspectors training school and the gear-grinding section. At the back of the floor is the plating and finishing department, the armature winding and finishing shop, and in the right-hand corner, the final component assembly and test sections. From this last section the finished units are transferred to the stores for dispatch from the factory.

Test Facilities

Installed at one end of the test building, the sea-level low-temperature and the high-altitude chambers are employed by Rotax for simulating environment operating conditions for all types of ancillary equipment. Apart from providing reduced density conditions, the high-altitude chamber can also be used for the simulated testing of ram-air-cooled components in aircraft which do not exceed M=1.2 at 36,000 ft. and above. It is proposed to build an additional chamber to deal with the higher air temperatures encountered at speeds of up to M=2.5.

The sea-level cold chamber is used for sub-zero testing of such units as undercarriage actuators, which although normally required to operate at low altitudes have been subjected to the extremely low temperature during a flight and may still be very cold when the aircraft comes into land. Components tested in the high-altitude chamber include generators, motors, alternators and all units employing brushes, commutators or slip rings, when the dry air at altitude can effect brush-wear.

Controlled by a three-stage compressor plant using Freon as the refrigeration medium, the cold chamber has a temperature range of +20° C. to −70° C. The high stage of the compressor will cool the chamber to −15° C. in 1 hr., the addition of the intermediate stage will reduce the temperature to −40° C. in a further 2½ hr. From −40° C. to −70° C. takes 22 hr. with the use of the final stage. Measuring 25 ft. × 15 ft. × 10 ft. high, the chamber has a working width of 12 ft.



Final assembly and inspection of linear actuators for aircraft undercarriage applications.

Apart from providing sub-zero conditions the chamber design must ensure that no frost is deposited when the temperature is reduced. This is obtained by the circulation of dry air from a twin re-activating silica-gel plant and ensuring that no fresh air is brought into the chamber before reduction in temperature.

Designed to operate at heights up to 60,000 ft. at any temperature between +20° C. to −60° C., the high-altitude chamber can simulate its maximum altitude in 2 min., reduce the air to −30° C. in 2 hr. and lower it to −65° C. in 7 hr. One of the most important factors at high altitude is the dryness of the air with which blast-cooled aircraft equipment is supplied, and the chamber can simulate air at a frost point of −60° C. at sea level, which is the equivalent of −75° C. at 50,000 ft.

The effects of high-altitude conditions on electrical machines fall, broadly, under two headings: brush-wear and cooling. The first is caused by increased friction and has been reduced in general to practical limits, but the problem of over-heating becomes increasingly difficult as the inlet temperatures of the ram-air rises with the higher operating altitudes and airspeeds.

Fitted with an externally mounted 170-h.p. motor for driving generators and alternators up to a maximum speed of 10,000 r.p.m., the chamber has a working area of 8 ft. by 6 ft.

The generator test house is designed for the checking of complete four-engine aircraft generator and control systems, and floor space has been allowed to increase the drive motors by two if the requirement for a six-engine layout is brought out. Using dummy loads, the equipment is normally employed in the ground testing of aircraft electrical systems rather than development of individual components.

A second view of the main production shop from the right-hand side of the floor with the actuator assembly and test sections in the foreground. During manufacture all work progresses from the front to the back (and right) of the building.

Photographs copyright "The Aeroplane"

NEWS ABOUT PEOPLE

TO C.A.A.—Mr. Max Stuart-Shaw, assistant general manager of Aer Lingus, is relinquishing his position to become general manager of the Central African Airways Corpn. in Salisbury, Rhodesia.

ABOUT A.S.R.—Air Cdre. R. T. Gething, O.B.E., A.F.C., will speak on "Air Search and Rescue Problems" to the Inst. of Navigation, at 17.15 hr. on February 21. The lecture will be at the Royal Geographical Society, 1 Kensington Gore, London, S.W.7.

UNITED APPOINTMENTS.—The directors of United Air Lines have advanced seven of their officers to senior vice-presidencies as follows: R. F. Ahrens (personnel); Curtis Barkes (finance and property); J. A. Herlihy (engineering and maintenance); R. E. Johnson (sales and public relations); D. F. Magarrell (transportation services); H. E. Nourse (economic controls); and D. R. Petty (flight operations).

M.L. DIRECTOR.—Mr. M. R. Mobbs has been elected to the boards of the M.L. Aviation Co., Ltd., and of the M.L. Engineering Co., Ltd., the parent company.

AER LINGUS APPOINTMENTS.—Mr. R. E. Van der Veld has been appointed Aer Lingus city traffic superintendent in Manchester, where the company is opening a new office in March. Other appointments in this office are Mr. John Crowley to be reservations supervisor and Mr. Sean Daly to be sales officer. Mr. Eric Allamand has become northern sales superintendent.

HIGH FLIGHT.—An Avro flight test crew at Woodford, with Mr. J. Harrison, chief test pilot, fourth from the left. All are wearing anti-g suits, partial-pressure jerkins and partial-pressure helmets for Vulcan test flights above 50,000 ft. The helmets, manufactured by Baxter Woodhouse and Taylor, Ltd., have a vizor which is normally worn open but in the event of cabin-pressurization failure automatically closes to seal off the face mask to maintain sufficient oxygen pressure. There is a mouth door for in-flight feeding.

ELSTREE AGAIN.—At the A.B.A.C. dinner at the Waldorf on February 7, the Rt. Hon. A. T. Lennox-Boyd presented his trophy to Mr. David Ogilvy, chief instructor of the Elstree Flying Club.

C.P.A. CONSULTANT.—We understand that Mr. A. C. Campbell Orde, who recently resigned from his position with B.O.A.C., is making his wide experience of new aircraft equipment available to C.P.A. in a consultative capacity.

EMPLOYMENT FIGURES.—According to information issued by the Ministry of Labour, 260,900 people were employed in the manufacture and repair of aircraft in November, 1957. This compares with 261,300 in September and 261,500 in October of 1957, and 264,500 in November, 1956.

G.A.T.C.O. OFFICERS.—Mr. W. C. Woodruff, A.T.C. officer i/c at London Airport, was installed as Master of the Guild of Air Traffic Control Officers on February 8. Mr. G. Chambers was elected Clerk of the Guild and Mr. G. C. Burch, treasurer, in succession to Mr. S. G. Fitch and Mr. J. MacDonald.

MILES REPRESENTATIVE.—Maj.-Gen. J. C. Haydon, C.B., D.S.O., O.B.E., has recently joined the Miles Group of companies and will be available to act as the representative of the directors of the Group on all matters referred to him. He will be known as board representative.

MILITARY AVIATION AFFAIRS

MEMORIAL LECTURE.—The First Trenchard Memorial Lecture will be given by the Chief of the Air Staff, Marshal of the R.A.F. Sir Dermot Boyle, G.C.B., K.C.V.O., K.B.E., at the Halton Branch of the R.Ae.S. on February 20. The meeting will be held in the Burnett Gymnasium, Halton Camp, at 18.45 hrs.

U.S. FORCES IN BRITAIN.—In answer to a question in the House of Commons last week, Mr. Duncan Sandys, Minister of Defence, stated that there are about 36,000 members of the United States armed forces stationed in the U.K. In addition, 500 civilians are employed in an auxiliary capacity.

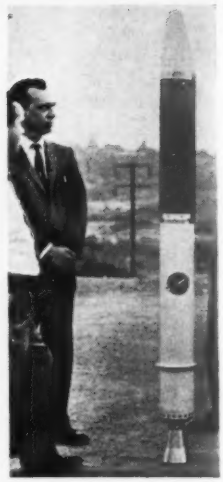
R.A.F. LECTURES.—For the second successive year Air Chief Marshal Sir Thomas G. Pike, A.O.C.-in-C., Fighter Command, has been invited to lecture to the U.S.A.F. War College, Maxwell A.F.B., and to the R.C.A.F. Staff College, Toronto, on "The Air Defence of the United Kingdom." Air Vice-Marshal S. O. Bufton, S.A.S.O., Headquarters, Bomber Command, is to lecture at both colleges on "The Offensive Capabilities and Employment of R.A.F. Bomber Command."

CADET PILOTS.—Since the £150 flying scholarship scheme for air cadets started in 1950, some 2,000 cadets of the Air Training Corps and the air sections of the Combined Cadet Force have been selected for pilot training on light aircraft. By December 31, 1957, 1,982 air cadets had qualified, and another 258 are under instruction or are waiting to start flying.

R.A.F.A. FUNDS.—On February 12 H.R.H. The Duchess of Gloucester, vice-patron of the R.A.F. Association, was to receive a cheque on behalf of the Association for £7,586, representing the proceeds of collections taken in the foyers of 286 cinemas of the Odeon circuit during last year's Battle of Britain Week and Wings Day. The money will be devoted to the welfare work of the R.A.F.A.

U.S.A.F. IN SPAIN.—A recent report to the U.S. Government Operations Committee stated that the U.S.A.F. wasted $5,900,000 by constructing a totally unnecessary air base at San Pablo, Spain. Another base at Tarejon, near Madrid, which is being used by only one fighter squadron, is of limited value because the landing patterns overlap with those of a nearby civilian airfield.

The Jovial Explorer



IF a history of the beginning of space adventure ever comes to be written during the next century or so, it will certainly record (with mild amusement) that first attempts to push a satellite into orbit round the Earth were made with a remarkable assortment of hardware, primarily intended for quite another purpose.

Vanguard, for instance, though as yet unsuccessful, is made up of a modified research rocket the Viking; a second stage copied from another research rocket the Corporal; a third-stage solid propellent rocket, and a satellite (?) no bigger than a large grapefruit. What the Sputniks were launched with the Russians are not telling, but it is a safe bet the carrier vehicle was a Soviet IRBM, or perhaps even an ICBM. Makeshift methods seem to be the order of the day, the reason being that no Government can afford to do otherwise. Space flight, when it eventually arrives, looks like being the orphan child of some other more materialistic project.

The Jupiter-C satellite vehicle, with which the United States has just qualified for entrance to the exclusive club of Outer Spacers, belongs also to this crazy mixed-up category. The first stage of this four-stage vehicle is one of the U.S. Army's Redstone missiles, a medium-range, surface-to-surface rocket, ordinarily capable of 200-300 miles with a design payload of a megaton bomb. Ready for action a production Redstone stands 63 ft. high on its four stubby fins, has a body diameter of 6 ft. and weighs around 40,000 lb. But, dressed for satellite delivery, Jupiter-C has an overall height of 68 ft. 7 in. and a weight of 65,000 lb.

Adding somewhat to the general confusion is the fact that the U.S. Army also owns and operates from time to time another missile by the name of Jupiter, a considerably larger IRBM with a range of 1,500 miles. This missile, which has a very much fatter body (100 in.), employs a gimbal-mounted Rocketdyne motor giving a thrust of 135,000 lb. and has a launching weight of 100,000 lb. Although bearing a distinct family resemblance both in shape and height—after all, it was designed by the same team at the Redstone Arsenal—it should not be associated with Jupiter-C, which is basically the earlier Redstone design.

To complicate the issue still further a Redstone test vehicle, also masquerading under the name of Jupiter-C, was used to evaluate nose-cone re-entry problems during the summer of last year. This vehicle, a three-stage affair consisting of a Redstone first stage, four solid-propellent Recruits for a second stage, and a single Recruit as the final, nose-cone-bearing third stage, achieved the phenomenal distance of 3,300 miles and a speed of 12,000 m.p.h. Later the nose cone was salvaged intact close to the target.

Four Steps Into Space

To prepare the Redstone missile for satellite launching its tankage was increased in length, the propellents being liquid oxygen and a new, so-called "exotic" fuel known as "Hydyne." The latter is probably one of the diborane or pentaborane compounds of boron and hydrogen that are said to increase the specific thrust by as much as 20%. Naturally this is at the expense of hotter combustion temperatures which, in a motor chamber designed to operate with ethyl-alcohol fuels, is an open invitation to all sorts of cooling troubles. Apparently these have been overcome, for the gingered-up motor is reported to be developing 83,000 lb. of thrust at take-off, and there is enough propellent in the lengthened tanks to allow full thrust for 140-150 seconds.

Above the propellent tanks of a normal Redstone lie the warhead and guidance compartment. At the peak of its trajectory the nose is intended to separate from the empty shell of the tank structure and continue to fly a ballistic path to the target. Four small external fins at the base of the cone are intended to stabilize the flight during descent. For the Jupiter-C satellite configuration the nose compartment has been reduced in height though the small fins on the skirt are kept. It must be presumed that there has been no radical change in the Redstone guidance system because of the limited amount of time the Army had to get ready, though this cannot preclude the possibility that the other Jupiter guidance was fitted. Both are inertial guidance systems, employing air-bearing gyros to stabilize the platform, though a radio-inertial system is an alternative feature for Jupiter. Both systems are reliably proven.

Above the nose cone that houses the guidance equipment is perched what has been somewhat vulgarly termed "the bucket," a large, cylindrical container resembling a 3-ft. diameter dustbin. This "bucket," which is made to revolve at 500 r.p.m. by an electric motor so as to spin-stabilize the last three stages, contains a cluster of 11 small solid-propellent rockets forming the second stage. Each rocket is 40 in. long and 6 in. in diameter.

Surmounting this cluster is a further group of three solid-propellent rockets of similar size, representing the third-stage propulsion unit. Together they enclose and support a fourth rocket, to a forward extension of which is wedded the cylindrical satellite package, the Explorer. The fourth stage, together with its instruments, is some 80 in. overall, 6 in. in diameter, weighing after burn-out 31 lb., of which 11 lb. is the net instrument payload.

Those interplanetary enthusiasts who were horrified at the poor 1 : 1100 ratio of payload to vehicle weight of the Vanguard, but were hoping that the index of efficiency would improve the bigger the launching vehicle, are even more demoralized by the 1 : 6000 ratio of Jupiter-C. No one has had the courage to ask the Russians what payload index they managed to achieve.

Ascent Into Orbit

Immediately prior to the final count down at Cape Canaveral the satellite's telemetry circuits were energized and checked for functioning. The "bucket" was then spun up to speed—probably from an external power supply—before the first-stage motor was ignited. For a few seconds the motor was allowed to build up partial thrust whilst the pumps ran up to speed, and then full thrust was turned on as soon as the state of the flame was considered satisfactory.

Jupiter-C then rose steadily and climbed rapidly away, heading south-east down the Florida Missile Range with its speed and altitude continuously tracked by radar. At a height of 60 miles, and at a speed not specified but which was probably over 4,000 m.p.h., at roughly 45° to the horizon, the first-stage tanks became exhausted. The entire guidance compartment in the nose, together with the next three stages, then separated and continued to coast upwards whilst the first-stage shell dropped away. The coasting phase up to the orbital height of 200 miles took 240 seconds, during which time compressed air jets controlled by the guidance system monitored the cluster attitude and kept the structure aligned roughly horizontally.

Meanwhile tracking radars were keeping the ground control centre informed as to the speed and height of the coasting unit. Telemetry signals monitoring the gyros in the guidance unit may also have been used to indicate whether orientation was correct. At the precise moment when the cluster had reached orbital height and direction a radio command signal from the ground fired the second stage. The "bucket" having previously been jettisoned, the last three stages were thereby committed to the orbit.

The rest was automatic. For six seconds the 11 rockets of the second stage fired continuously, stabilized in the direction of thrust by the fact that the cluster was still spinning. After a delay time of two seconds the third stage fired and separated. In another six seconds these too were burnt out and the last stage sent on its way.

By the time the fourth and final stage had been firing for six seconds, the satellite, together with the empty casing, was orbiting at 18,000 m.p.h. The satellite, so to speak, was in business. From the moment it had left the ground to the moment the Explorer was orbiting the operation had taken 6 minutes and 52 seconds.—I.G.WHY.

PRIVATE FLYING

H.J.C.'s Club Commentary:

A.B.A.C. Membership

A Croydon Club

● THE tenth annual report of the Council of the **Association of British Aero Clubs and Centres** includes details of changes which have taken place with regard to affiliation during the past year. The new member clubs are the Merseyside and North Wales Flying Club, the Scottish Aero Club and the Southern Aero Club. In the associate membership class the following clubs have been accepted: A.P.T. Flying Club, Beaver Flying Club, Blackburn and General (London) Flying Club, Edinburgh Flying Club, Field Flying Club, North London Aero Club, Northern School of Aviation Flying Club, Percival Flying Club, Sculthorpe Flying Club and Skyways Flying Club. The Cinema Flying Club and the Kelvin and Hughes Flying Club are new affiliate members.

Four full-member clubs resigned: the Blackpool and Fylde Aero Club, the Liverpool Flying Club (which has been reconstituted as the Merseyside and North Wales Flying Club), and the Scottish Flying Club and the Strathtay Aero Club, now merged as the Scottish Aero Club.

The Royal Engineers Flying Club has resigned from associate membership; the Christchurch Aero Club and the Skegness Aero Club have transferred from associate to full membership, and the East Riding Flying Club from full membership to associate membership.

● DURING what was probably the last full flying year at Croydon Airport, the Auster 5 and Tiger Moth of the **Croydon Aero Club** together logged 587 hr. and members gained one C.P.L., six P.P.L.s and three night ratings. The target for the current year is 750 hr.

A navigation competition was held during the summer, marks being awarded for accurate flight planning and time-keeping and for identification of turning-points.

The winning crew was composed of C. Denny and J. Moyse, and two lady members came second. This year's competition is to be on a more ambitious scale and there will be a £5 5s. first prize.

Since last autumn weekly lectures and social meetings have been held at the airport, and night flying is available whenever the weather allows it to be done.

The company operating the club cannot, unfortunately, continue to subsidize flying; maintenance, including the C. of A. renewal, costs £1 2s. 2d. an hour, so the hourly flying rates have had to be raised to £2 10s. and £2 15s. for the Tiger and Auster respectively.

This is still a reasonably low cost, and the club wants to increase its membership. There are only a few vacancies for student pilots, but plenty of room for P.P.L. members. The secretary of the club is Mr. D. C. Perch; the address is 30 Abbots Green, Addington.

A Ball at Hatfield

● THE CHAIRMAN of the **North London Aero Club**, Mr. Leslie O'Connor, C.B.E., writes us that the club's annual ball is to be held in the Cranbourne Rooms, Hatfield, on Friday, April 11. It will begin at 20.00 hrs. and continue until 02.00 hrs. Tickets cost 25s. each, inclusive of running buffets, and application should be made to the entertainments committee of the club at Panshanger aerodrome. Dress is optional.

A New Italian Tourer

MAKING its first flight on January 16, the F.14 Nibbio (which means Kite), is a four-seat low-wing monoplane directly derived from the two-seat F.8L Falco. It is produced by the Societa Aviamilano of Milan.

The new aircraft, which is built entirely of wood, has been designed by Stelio Frati. It has a 180-h.p. Lycoming O-360 flat-four engine driving a two-blade Hartzell constant-speed propeller, and tanks in the wings hold a total of 34.2 Imp. gal.

The wing is of NACA 64000 aerofoil section, with a single main spar, and secondary spars to which the landing gear and control surfaces are attached. The retractable nose-wheel landing gear is electrically operated.

Access to the cabin is by a door on the right-hand side. The seats are arranged in two pairs, with room for 77 lb. of baggage.

DIMENSIONS.—Span, 31 ft. 1¼ in.; length, 23 ft. 10 in; height, 8 ft.; wing area, 138.85 sq. ft.

WEIGHTS.—Empty, 1,433 lb.; disposable load, 992 lb.; loaded, 2,425 lb.

PERFORMANCE.—Maximum speed (at sea level), 192.6 m.p.h.; cruising speed (at 6,560 ft.), 180 m.p.h.; minimum speed, 57 m.p.h.; take-off run, 197 yd.; landing run, 164 yd.; take-off distance to 50 ft., 492 yd.; climb to 6,560 ft., 8 min.; ceiling, 17,720 ft.; range (at 4,920 ft., without extra fuel), 621 miles.

GLIDING NOTES

WAVES were operating at the Midland Gliding Club during the week-end February 1-2. On the Sunday, in a west wind of 15-20 knots, they were exceptionally good. Ted Stark climbed 9,900 ft. to reach 11,300 ft. above sea level, and the climb, if confirmed, will complete his Gold "C" tests. In the club Skylark Robert Swift, a young and comparatively new member, reached 10,900 ft. a.s.l.

The Army Gliding Club has been keeping its Skylark at the Long Mynd throughout the winter, and Mr. Barrell (rank not stated) seized this opportunity and climbed to 10,900 ft. a.s.l., besides doing a 5-hr. flight towards his Silver "C." Daphne Pointer also flew for 5 hr.

A dearth of news from the British European Airways Gliding Club has been explained by Peter Goodfellow. For one thing, the club does not exist under that name; it is really the Gliding Section of the B.E.A. Silver Wing Club, which has subsidized the flying of some of its members at Lasham and Dunstable by paying part of their entrance fees and subscriptions. Now, at last, they have got permission to use Booker airfield, so will have a ground of their own, though they will be sharing it with Bomber Command's Gliding Club. Membership consists mostly of ground staff, but a few B.E.A. pilots have joined too, and Lord Douglas of Kirtleside is the president. They have a Tutor, and will start flying as soon as a winch arrives; later, a T-21b will be added to the fleet.

* * *

SO MANY outstanding cross-country flights in Europe, including Great Britain, have been made during the spring, especially in the past year or two, that the German Aero Club has decided to hold the next national gliding contest in May, 1959. This is against all precedent; national gliding contests in the northern hemisphere have been held occasionally in June, often in July, commonly in August and rarely in September. But May! It was time somebody woke up to the obvious.

This year, Martin Deskau writes, several inter-club competitions will be held in Germany. There is also to be a competition, though a non-flying one, for the Oskar Ursinus prize of 5,000 DM, offered by Germany's Transport Minister in memory of the "father" of gliding. The "theme" for the prize is the avoidance of accidents, and competitors can "enter" any kind of device, or improved methods of construction, instruction, navigation, coping with the airways problem, and so on. Among the seven judges are Heinz Kensche and Fritz Stamer.

* * *

WHIRLWINDS, called dust devils when dusty and waterspouts when watery, appear in this country in such modest form that they are apt to turn into ordinary thermals higher up, and such a one is described in *Weather* for February. It was seen at Flatford Mill Field Centre at about 14.30 hrs. on May 6 last year, when, according to weather records, the maximum temperature in those parts was only 49° F., but a wind from far north should have produced plenty of instability.

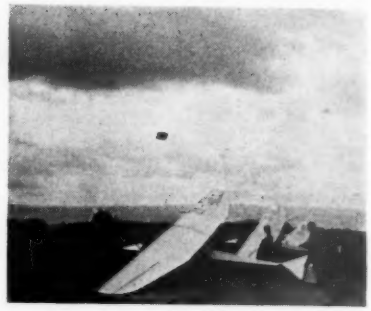
Mr. D. T. Pedge writes that the eye of the whirlwind was only a foot across at ground level but made a noise like "a gale from the B.B.C. sound effects department." Students at the Centre threw handkerchiefs and a pullover into it. The pullover soared to over 60 ft., making four circles of 40-yd. radius. One handkerchief shot straight up out of sight; the others went round in circles of increasing size till they were flung out of the upcurrent, but the peculiar behaviour of one handkerchief was of special interest. It made the record number of 13 circuits with a radius of about 20 yd., during which it touched the ground at one point of each circuit and rose to about 20 ft. at the opposite point.

One can understand the plane of rotation being tilted at an angle of 1 in 6 if the axis of the whirlwind was similarly tilted (Mr. Pedge gives no evidence on this point), provided that it happened high up, but how could it happen so close to the ground? I have just tested my own handkerchief and it falls at 6 ft./sec. through still air, so in the Flatford Mill whirlwind the air at one point must have been actually leaving the ground with a vertical component of this speed.

A High-performance Two-seater

MAKING its first flight at the end of last year, the C.V.V.8 Bonaventura two-seat high-performance sailplane was built by the Polytechnic School of the University of Milan. It is an all-wood aircraft, with a laminar-flow wing, and has been built to the designs of Ing. E. Preti. It is to form part of the equipment of the National Gliding Centre at Rieti.

The Bonaventura has a wing span of 62 ft. 3 in. (19 m.) and a length of 26 ft. (7.9 m.); the aspect ratio is 18. Loaded, the sailplane weighs 1,058 lb. (480 Kg.).



IN NEW ZEALAND.—A scene at Waharoa, where the Auckland Gliding Club spent its New Year camp. The 2,000 ft. soaring ridge just visible in the background is eight miles away.

AUCKLAND GLIDING CLUB held its usual New Year camp in North Island, New Zealand, at the Piako Aero Club's site at Waharoa, 80 miles S.E. of Auckland. The Tauranga Gliding Club, from the east coast, joined in, and the assembled fleet consisted of an EoN Baby, Olympia, Skylark 2, L-Spatz, Bergfalke and two of the T-31 type. Launches were by aero-tow.

The outstanding day was December 31, when John Hadlow fulfilled the distance, height and duration tests for Silver "C" in one flight, though only two at a time are allowed officially; he reached 10,000 ft. in wave lift without knowing how many feet there are in 3,000 metres. Rene Thomson reached 10,300 ft. in the EoN Baby. A most unusual type of flight this day was by Roy Kemp, who took off at 17.27 hrs., contacted sea-breeze lift coming in from the Pacific, and rose to 6,500 ft. Altogether, 246 hr. were flown during the period December 26 to January 12.

Keith Wakeman has already been chosen to represent New Zealand at this year's World Gliding Championships, but it is now announced in the Auckland Press that the New Zealand Gliding Association "will also sponsor a former Fleet Air Arm pilot, Mr. P. Cummings, of South Canterbury, and Mr. Christopher Wills, of Christchurch, one of whom may fly for New Zealand with Mr. Wakeman if the Dominion enters a team in the two-seater events." Actually, there are no two-seater events, but two-seaters can, presumably, fly in the contest.

Christopher Wills and Jon Hamilton together have broken the New Zealand two-seater records for both height and distance. The date was January 31, and they were taking part in the Canterbury Club's annual camp at Simons Hill, which is in the foothills of the Southern Alps in South Island. They reached an absolute altitude of 26,000 ft. after a gain of height of 19,000 ft., but their distance from Tekapo in the hills to Christchurch on the coast, given as 210 miles, is only 140 miles on the map, unless they covered a dog-leg course.

* * *

A SEVENTH club has offered to hold a meeting during National Soaring Week from July 26 to August 4; it is the Kent Gliding Club, at Detling, and as they will want about a dozen sailplanes competing, there will be room for several visiting teams to take part.—A. E. SLATER.

CORRESPONDENCE

The V.C.10

ILLUSTRATIONS in your article "The Thinking Behind the V.C.10," THE AEROPLANE, January 24, made me think of one thing in particular: the wonderful view that passengers in the front half of this aeroplane will have.

Many readers will immediately say that on transoceanic journeys at 45,000 ft. there will be nothing to see, but that is by no means all the story. I have flown by B.O.A.C. to N. America and have enjoyed early morning and evening views en route from Iceland to New York, also from Montreal across New Brunswick. Also there are unlimited opportunities on all other potential V.C.10 routes.

Boredom may well be the main enemy of future long-distance air travel and airlines would be wise to encourage their customers to "look at the view."

Boxmoor, Herts. D. G. DENOON.

No-Go, the Other Way

THE amusingly recorded experiences of your contributor, "D.G.", while trying to fly from London to Amsterdam ("The No-Go Problem," January 24, p. 106) prompt me to relate, without malice, a similar series of events before a journey in the opposite direction—and with the "opposite" airline:—

18.15. Report at Schiphol half an hour before departure of K.L.M. flight KL 137 to London, having changed original booking from KL 145 (22.10 departure) and ignored flight BE 427 (20.30 departure).

19.00. Shepherded into coach outside terminal building. Snow is falling; so are personal spirits.

19.02. Arrive in hangar and board Viscount. Aircraft almost full.

19.10. Viscount is towed out of hangar.

19.15. Viscount engines started, then stopped.

19.17. Captain announces failure of a hydraulic pump on No. 4 engine.

19.18. Disillusionment of press baron V.I.P. in forward saloon.

19.24. Coach arrives to remove passengers to terminal building. Snow still falling.

19.30. At terminal building passengers are handed vouchers worth one drink (of any sort). Several passengers wisely ignore this bribe and endeavour to book on next B.E.A. flight.

20.00. Dinner is served, with the compliments of K.L.M. Delay here suggests that a hydraulic pump in the kitchen has failed.

20.30. Grandstand view from restaurant of B.E.A. flight to London preparing to depart.

20.40. Dinner not finished, but remaining passengers re-board coach for hangar.

20.45. Board different Viscount in different hangar. Aircraft half-empty this time.

20.50. Tractor towing Viscount from hangar skids on snow.

20.55. Delay because of bad visibility—snow still falling.

21.00. Take off.

22.00. Arrived L.A.P.: "K.L.M. hopes you have enjoyed your flight. . . ."

London, E.C.1. J.F.M.

L.A.P. Monorail

I REALLY cannot congratulate you on your article about the possible monorail link with L.A.P. (THE AEROPLANE, January 24). It misses the point completely.

As I gathered from the Press, the idea is that each "train" would be Diesel-driven and consist of a coach equipped also with steerable road wheels to enable it to drive (relatively slowly no doubt) between the western terminal of the monorail somewhere near L.A.P. North and the nearest accessible point to where the aeroplane concerned is parked; similarly at the London terminal of the monorail they would be able to distribute passengers to, and gather them from, several different air stations, if necessary. Such an arrangement, by presumably rendering all monorail junctions and electrification unnecessary, would reduce cost and time of building the track.

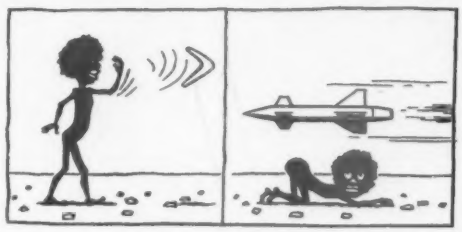
Alas, your remarks appear to be only too true about the time needed to ensure that such an arrangement is safe.

I suggest some correction or rather elaboration of your article would not be out of place, as it puts a very different aspect on the project, indeed.

London, W.2. D. M. HAY.

[If the monorail scheme can be so developed as to combine the advantages of road and rail travel, it would indeed put a different aspect on the project. Such a development, however, is a considerable advance over the scheme as it exists at present, and would seem likely to delay still further the day when satisfactory transport facilities are available between London and its Airport. We have no axe to grind over the monorail—additional details of which were made available after our comments had gone to press; our only concern is that in waiting for what may seem to be the best we may miss the chance of having a satisfactory solution sooner.—ED.]

Groundabout



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History Re-written—1. As the years pass, men will argue about what has been aviation's greatest step forward. Montgolfier? Wrights? Whittle? Sputnik? All these pale into insignificance before a simple announcement in *American Aviation* of December 30: "DC-8 to be equipped with flush toilets."

*

History Re-written.—2. A friendly reader, Mr. K. McCall, sends some startling news from Pakistan. Did we know, he asks, that a 1938 Vatican airmail stamp provides evidence that Whittle and his airborne turbine were pre-dated by centuries by the prophet Elijah? I bought the stamp and, by heavens, there you have it—shock waves, afterburning, STOL, and a legend reading: ET ASCENDIT ELIAS PER TURBINEM IN COELUM.

*

Dig That Crazy Pitch-up! Vickers may not know it but they have an active publicity branch at R.A.F. Geilenkirchen where No. 2 Sqn. have produced a powerful leaflet about their equipment entitled: "To Hell with Thrift—Buy a Swift!" In sober, considered terms, it sets out that recce.-fighter's virtues: "Point your feet skywards! Wind her up to Full Grunt Level! Then Pop that Tail-end Racket Packet! Real Urge Surge! 40,000 ft. in the Flicker of a Doll's Eye! You're Safe in a Swift with its built-in Sonic

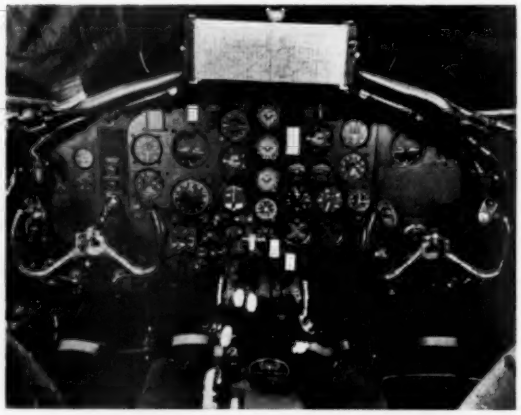
Dig-Rig to Check that Peck! Complete with Hot-to-Trot Afterburner! Price, in Standard 3-tone Matt Finish: £250,000, including Ladder. Britain's Finest Mach Hack!"

*

"My wife tells me the kids want to know who is the man who keeps his flying helmet in the house."

by Gren

NOTES AND EVENTS



DECCA IN GERMANY.—Four Hunting Pembrokes of the West German Air Force and six of the Naval Air Arm are being fitted with the Decca Navigator, the cockpit installation of which is seen in the accompanying photograph. The Flight Log is on the coaming, with the Decometer immediately below it on the flight panel.

LUFTHANSA NEWS.—On February 1, Lufthansa opened a new town office at 4 Victoria Arcade, 32 Deansgate, Manchester, 3. The telephone number for reservations is Deansgate 6241-2. Mr. H. Trommer has been appointed resident engineer for Lufthansa at Vickers' Weybridge works for the period of delivery of this airline's nine Viscount 814s.

Brush up your Meteorology

A VACATION course in meteorology is being held at the Meteorology Department of Imperial College in South Kensington from April 10 to 16, 1958. Lectures will cover dynamic meteorology and climatology, synoptic meteorology and the principles of weather forecasting, and the latest research work on subjects such as artificial rainfall, air pollution, oceanography, and the effect of weather on locusts. The Department's Field Station in Berkshire will also be visited.

The inclusive fee is £5 5s. for non-residents, or £11 including accommodation and most meals. Applications to: Deputy Director (Extension), Dept. of Extra-Mural Studies, Senate House, Malet Street, London, W.1, and not later than **February 15,** because the number of places is limited.—A.E.S

NO SALE.—A bid of $800,000 by de Havilland Aircraft of Canada for the Fleet Manufacturing Co., was not accepted at a recent meeting of shareholders.

SELLING AIRCRAFT.—The Aircraft Marketing Co. of Los Angeles has introduced a multiple listing service for the sale of commercial aircraft through franchise representatives all over the World. The main advantage, it is claimed, is that fast sales action, benefiting both buyers and sellers, can be made. Agents receive brokers commissions for obtaining exclusive listing or selling available aircraft, and no charge is made to the owner of an aircraft not sold.

BREWERS' DOVE.—The six-seat Dove used as an executive transport by Ind Coope and Allsopp is being equipped with a Decca Navigator and automatic pilot. This aircraft was recently used by the company on 73 days out of 79 and carried 300 passengers on 127 flights to points in the British Isles and on the Continent.

ELLIOTT EXHIBITS.—Components on the Elliott Bros. (London), Ltd., stand at the Physical Society Exhibition to be held at the Horticultural Hall, London, between March 24 and 27, will include an air data computer for supplying continuous aircraft flight information, a prototype rate gyro, printed circuits and other units for guided missiles, and a transistor power unit.

1958 I.E.A. EXHIBITION.—Items on show at the 1958 Instruments, Electronics, and Automation Exhibition to be held at Olympia, London, from April 16 to 25 will include aeronautical communication, navigational and radar equipment, and aircraft instrumentation.

SERVOMOTOR PRODUCTION.—Muirhead and Co., Ltd., is now producing Size 10 servomotors suitable for miniaturized systems. With an overall diameter of 0.940 in. and overall length of 0.978 in., the servomotors weigh 1.45 oz. and have a minimum torque at stall of 0.29 oz. in., and minimum no-load speed of 6,500 r.p.m.

Aviation Calendar

February 18.—R.Ae.S. section lecture, "Aero-elastic Problems Associated with High Speeds and High Temperature," by E. G. Broadbent, A.F.R.Ae.S., in the Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

February 19.—Kronfeld Club lecture, "North Wales, the Soaring Pilot's Paradise," by Bill Crease, at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

February 19.—R.Ae.S. Leicester Branch lecture, "The Activities of the P.E.R.A. Organization," by R. Tilsley, A.M.I.Mech.E., A.M.I.Prod.E. (Production Engineering Research Assn.), in the lecture theatre, **Loughborough College,** at 18.45 hrs.

February 19.—R.Ae.S. Southampton Branch, Prize Papers, in the Inst. of Education, **University of Southampton,** at 19.00 hrs.

February 19.—Inst. of Prod. Engineers, Southampton Section, lecture (in conjunction with the R.Ae.S.), "Design and Construction of an Aircraft Carrier for Naval Operation," by A. J. Sims (Director of Naval Construction, Admiralty), at **Christchurch Town Hall,** Hants, at 19.15 hrs.

February 19.—Inst. of Fuel, Melchett Lecture for 1957, "Nuclear Power Development. Some Experience of the First Ten Years," by Sir Christopher Hinton, K.B.E., F.R.S., F.Inst.F., at the Inst. of Civil Engineers, Gt. George St., **London,** S.W.1, at 17.30 hrs.

February 20.—R.Ae.S. Main Lecture, First Trenchard Memorial Lecture by Marshal of the R.A.F. Sir Dermot Boyle, G.C.B., K.C.V.O., K.B.E., at R.Ae.S. Halton Branch, in the Burnett Gymnasium, **Halton Camp,** at 18.45 hrs.

February 20.—Kronfeld Club film show, "The Sea Shall Not Have Them," at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

February 20.—R.Ae.S. Bristol Branch lecture, "Sale of Civil Aircraft," by R. White-Smith (Bristol Aircraft, Ltd.), in the conference room, Bristol Aircraft, Ltd., Filton House, **Bristol,** at 18.00 hrs.

February 25.—R.Ae.C. dinner for M. Randrup and W. Shirley (holders of World's aeroplane height record) at 119 Piccadilly, **London,** W.1, at 19.30 hrs. for 20.00 hrs. **(Cancelled.)**

February 25.—R.Ae.S. Section lecture, "Guided Flight Trials," by R. W. Boswell, O.B.E., at 19 Park Lane, **London,** W.1.

February 26.—R.Ae.S. Presidential Address, by Sir George R. Edwards, at Church House, Westminster, **London,** S.W.1, at 18.00 hrs., followed by reception at 4 Hamilton Place, **London,** W.1.

February 26.—R.Ae.S. Preston Branch lecture, "Problems associated with Non-metallic Materials in Aircraft," by N. J. L. Megson (R.A.E.) and E. W. Russel (R.A.E.), at the R.A.F. Association, **Preston,** at 19.30 hrs.

February 26.—Kronfeld Club lecture, "The Necessity for Aviation Insurance," by J. Riseley-Prichard, at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

February 26.—British Inst. of Radio Engineers lecture, "Dectra. A Long-range Navigational Aid," by C. Powell, at the London School of Hygiene and Tropical Medicine, Keppel St., Gower St., **London,** W.C.1, at 18.30 hrs.

February 27.—Aerodrome Owners' Association A.G.M., at 19 Park Lane, **London,** W.1, at 15.00 hrs., followed by Annual Dinner at Hyde Park Hotel, **London,** W.1.

February 27.—R.Ae.S. Bristol Branch lecture, "Servicing of Civil Aircraft," by I. Gregory (Chief Maintenance Engineer, B.E.A.), in the conference room, Bristol Aircraft, Ltd., Filton House, **Bristol,** at 18.00 hrs.

DEFENCE RADAR.—Decca Radar, Ltd., has received a contract amounting to about £500,000 for the supply of military electronic equipment for the West German Government.

Personal Notices

Births.

Carr.—On January 31, at the British Military Hospital, Rinteln, B.F.P.O. 29, to Heather, wife of Sqn. Ldr. Philip Carr, R.A.F.—a daughter.

Garin.—On January 24, at the R.C.A.F. No. 3 Fighter Wing Hospital, Zweibrücken, to Margaret (*née* Rolfe), wife of Alexander Garin—a daughter.

Greendale.—On January 26, at R.A.F. Hospital, Ely, to Joan (*née* Tye), wife of Flt. Lt. Stuart Greendale—a daughter.

Harries.—On January 26, at Cheltenham, to Patricia (*née* Pratt), wife of Flt. Lt. K. J. Harries—a son.

Johnston.—On February 2, to Patricia Ann (*née* Whitlock), wife of Flt. Lt. I. L. M. Johnston—a son.

Williams.—On February 2, at P.M.R.A.F. Hospital, Halton, to Alys (*née* Jones), wife of Sqn. Ldr. O. G. Williams, R.A.F.—a daughter.

Deaths.

Burns.—On February 1, suddenly at Basingstoke, Flt. Off. Edna Maude Burns, B.E.M.

Taylor.—On February 4, at a nursing home in London, Wg. Cdr. J. B. Taylor, O.B.E., R.A.F. (Retd.).

Company Notices

INCREASE OF CAPITAL

Redwing, Ltd. (241,665), Aeronautical engineers, etc., 340 Bensham Lane, Thornton Heath, Surrey.—Increased by £10,000, in 5s. ordinary shs., beyond reg. cap. of £50,000.

New Patents

APPLICATION ACCEPTED

792,350.—Fairey Aviation Co., Ltd.—"Aircraft."—April 20, 1955 (Jan. 20, 1954).

Application open to public inspection on March 26, 1958; opposition period expires on June 26, 1958.